

APPENDICES

APPENDIX I

PEST PROFILES

MUSEUM PESTS

CLOTHES MOTH (*Tineola bissolliella*)



Webbing Clothes Moth

Webbing clothes moth adults are yellowish or golden colored, 1.27 cm (1/2 in) long or less, with narrow wings of about 1.27 cm (1/2 in) wingspan, and are distinguished by a tuft of fluffy, fine bronze to reddish-gold colored hairs (pompadour) on a bronze head. The wings do not have spots. Adults do not feed, but they fly to find food materials on which they lay 40 to 150 eggs, which hatch in seven to ten days. Clothing moth larvae are about 1.27 cm (1/2 in) long, light cream-colored, with a dark brown head. The larvae do not form a protective case around themselves.

BIOLOGY

The life cycle ranges from two to six months, depending upon environmental conditions. Although the adult moths are weak flyers, they are known to move over 91 m (300 ft) in distance. The males fly to find and mate with females, who generally remain in dark and dimly lit areas. Females produce eggs that are glued to potential food materials in closets or other sites where clothes or other natural fiber or animal pelts may be stored. From two to four generations per year are possible in warm, heated areas.

DAMAGE

Only the larvae of the clothes moth will damage organic materials as the adults do not feed. Their preferred food sources are wool, silk, cotton and other organic materials. Clothing may be grazed on the finer portions of the cloth.

MONITORING

Carefully inspect organic materials for the presence of eggs or larvae, or evidence of feeding.

MANAGEMENT

Physical removal of larvae or thorough vacuuming of infested organic material can remove the insects. Carefully heating the material or structure to 60°C (140°F) for 40 – 60 minutes will kill eggs, larvae and adults. Thorough vacuuming of all cracks and crevices to remove lint or other organic material can help.

CASEMAKING MOTH (*Tinea pellionella*)

Adults are small; light brown to tan colored moths with a wing span of about 1.27 cm (1/2 in). The front wings have three dark spots and both wings have trailing edges of soft fringe. Larvae are about .94 cm (3/8 in) long and form a slightly smaller protective case (about .79 cm [5/16 in] long) around them which is made from the same material as that which they eat. They carry the case with them while feeding. Casemaking moths are general feeders on dried animal and plant proteins, dead insects and nests, animal carcasses, feathers, hair, etc.

BIOLOGY

Although adult moths prefer relatively dry conditions, 75% humidity is the most favorable condition for development of larvae. This moth prefers darkness and seeks out folds of fabric or secluded places to hide when disturbed. Rug lint and hair accumulations behind baseboards or in heating units are favored hiding places. The life cycle is about three to four months with one to two generations per year.



Casemaking Moth

DAMAGE

Clothes moths and casemaking moth adults do not feed but tend to remain close to the materials on which they developed. The adults are very attracted to and lay eggs on soiled materials of vegetable origin. The larvae are general feeders on hair, wool, fur, feathers, upholstered furnishings, piano felts and insect specimens. During feeding, the larvae leave distinctive silken trails on materials and produce round fecal pellets colored like the material being eaten. Any visual evidence of moths usually indicates a major infestation.

MONITORING

Carefully inspect organic materials for the presence of eggs, larval cases, or evidence of feeding.

MANAGEMENT

Physical removal of larvae or thorough vacuuming of infested organic material can remove the insects. Carefully heating the material or structure to 60°C (140°F) for 40 – 60 minutes will kill eggs, larvae and adults. Thorough vacuuming of all cracks and crevices to remove lint or other organic material can help.

WAREHOUSE BEETLES *Trogoderma variabile*

Adult warehouse beetles are brownish-black, about .30 cm (1/8 in) long and can fly. The larvae range up to .64 cm (1/4 in) long and vary from yellow-white to dark brown in color, depending in age.



Warehouse Beetles & Larvae

BIOLOGY

Eggs laid by the female become adults in about a month.

DAMAGE

Warehouse beetles are one of the more voracious feeders and most important pests in museums. These pests infest not only fabrics but also a wide variety of stored products. They feed on seeds of all kinds, dead animals, candy, dog food, dead insects, milk products, starches, stored cereal products, dried grain,

insect collections, hides and skins. If food is scarce, some will cannibalize one another or feed on their own cast skins, and can survive for an extended time without any food.

MONITORING

Place sticky traps at the floor/wall junction and near window sills. Pheromone traps to attract adult beetles can also be placed throughout the museum areas. Thorough observation of susceptible organic materials may disclose larval activity.

MANAGEMENT

Thorough cleaning and inspection of susceptible organic materials is necessary. Treatment of these materials with food-grade diatomaceous earth or borate compounds can manage the feeding larvae. Removal of all organic material may be necessary.

CIGARETTE BEETLE (*Lasioderma serricorne* [F]) AND DRUGSTORE BEETLE (*Stegobium paniceum* [L])

THE CIGARETTE BEETLE is .25 cm (1/10 in) long, reddish-yellow to brownish-red beetle with a stout, oval shape and may be confused with the drugstore beetle. The head of the cigarette beetle is hidden by the thorax in dorsal view and the beetle has a hump-backed appearance when viewed from the side. The .51 cm (1/5 in) long cigarette beetle larvae are dirty-white, hairy and have yellow-brown markings on the head capsule.



Cigarette Beetle

BIOLOGY

The cigarette beetle's life cycle usually takes about 90 days, depending on environmental conditions. Females lay up to 100 eggs. The larvae cannot develop below 18°C (64°F), nor survive in less than 35% humidity. Major swarming of adults occurs May and

August. The larvae are photophobic and tunnel through materials to create a chamber from bits of food materials in which they pupate. Adults only live from two to six weeks but are strong flyers and are attracted to light.



Drugstore & Cigarette Beetles

DAMAGE

Both the larvae and adults attack a wider range of products than other stored-food pests. They are primarily found in tobacco, spices, beans, books, drugs, wood (feeds on both hard and soft woods), paper, cellulose textiles, baskets, herbarium specimens, some upholstered furniture, grain-based rodent bait and cloth materials such as silk.

THE DRUGSTORE BEETLE is .25 cm (1/10 in) long, uniform light brown beetle that resembles the cigarette beetle. Drugstore beetles are slightly larger, more elongated, have striated wing covers, appear hump-backed, and have three segmented and clubbed antennae. Adults are covered with fine, silky hair. The larvae also resemble the larvae of the Cigarette Beetle and are white with a brown head capsule, but are much less hairy than the Cigarette Beetle larvae.

BIOLOGY

The life cycle of the drugstore beetle ranges up to seven months, depending upon environmental conditions. Adults lay eggs on a food source that hatch in two to three weeks, and the larval stage lasts up to five months. Up to four generations per year may be produced. Adults are often

not seen in infested materials because they hold their legs and antennae close to their body when at rest.

DAMAGE

The drugstore beetle will eat almost anything ranging from paper, fabrics, books, grain, flour, seeds, baskets, wooden objects, structural building supports, spices, leather, hair, wool, mummies, dry pharmaceuticals, medicinals, poisons, vegetable matter, etc., and will penetrate and damage sheet aluminum foil, tin and lead.

MONITORING

Place sticky traps at the floor/wall junction, near window sills, and within display cases. Pheromone traps to attract adult beetles can also be placed throughout the museum areas. Thorough observation of susceptible organic materials may disclose larval activity.

MANAGEMENT

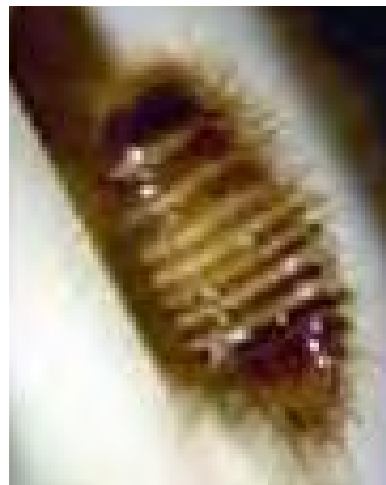
Thorough cleaning and inspection of susceptible organic materials is necessary. Treatment of these materials with food-grade diatomaceous earth or borate compounds can manage the feeding larvae. Removal of all organic material may be necessary. Carefully heating infested objects or the structure to 60°C (140°F) for 40 – 60 minutes will kill eggs, larvae and adults. Thorough vacuuming of all cracks and crevices to remove lint or other organic material can help.

DERMESTID BEETLES (Carpet Beetles)

There are a many different kinds of carpet beetles in the United States, and all have greatly varying life cycles and habits. Therefore, it is best to request pest identification by an insect specialist before considering management. In nature carpet beetles are scavengers that infest bird, mouse, rodent, tent caterpillar, old bee or wasp nests, and spider webs. In general, adult carpet beetles are broadly oval in shape, .15 - .3 cm (1/16 – 1/8 in) long, and calico, brown, or grayish in color. The round shape and mottled color distinguishes fabric beetles from such other stored-product pests as flour and grain beetles. Female carpet beetles lay up to 100 eggs, which hatch in about two weeks. Carpet beetle larvae are brownish or yellowish, about .64 – 1.27 cm (1/4 – 1/2 in) long, with slender bodies that taper towards a tail bearing tufts of hair on the upper surface. The larvae are covered with fine barbed hairs (an effective protection against insect predators). Larvae are generally found on products of animal origin. Adults are attracted to the light at windows. Below are examples of several pests of fabrics, furs and animal origin products.



Black Carpet Beetle
Attagenus megatoma



Dermestid Larvae



Anthrenus verbasci



Varied Carpet Beetle Larvae

BIOLOGY

Carpet beetle larvae feed on almost any organic material from dead birds, wasp nests, organic fabrics, skins, etc. The adult beetles feed on flowers and pollen.

MONITORING

Place sticky traps at the floor/wall junctions, window sills and in display cases. Thoroughly inspect organic material for larvae or evidence of feeding.

MANAGEMENT

Thoroughly vacuum all cracks and crevices to remove dust and lint. Carefully clean all organic fabric material. Treat cracks and crevices with boric acid dust or diatomaceous earth. Carefully heat the organic material or structure to 60°C (140°F) for 40 – 60 minutes to kill eggs, larvae, pupae and adult beetles.



Furniture Beetle Larvae



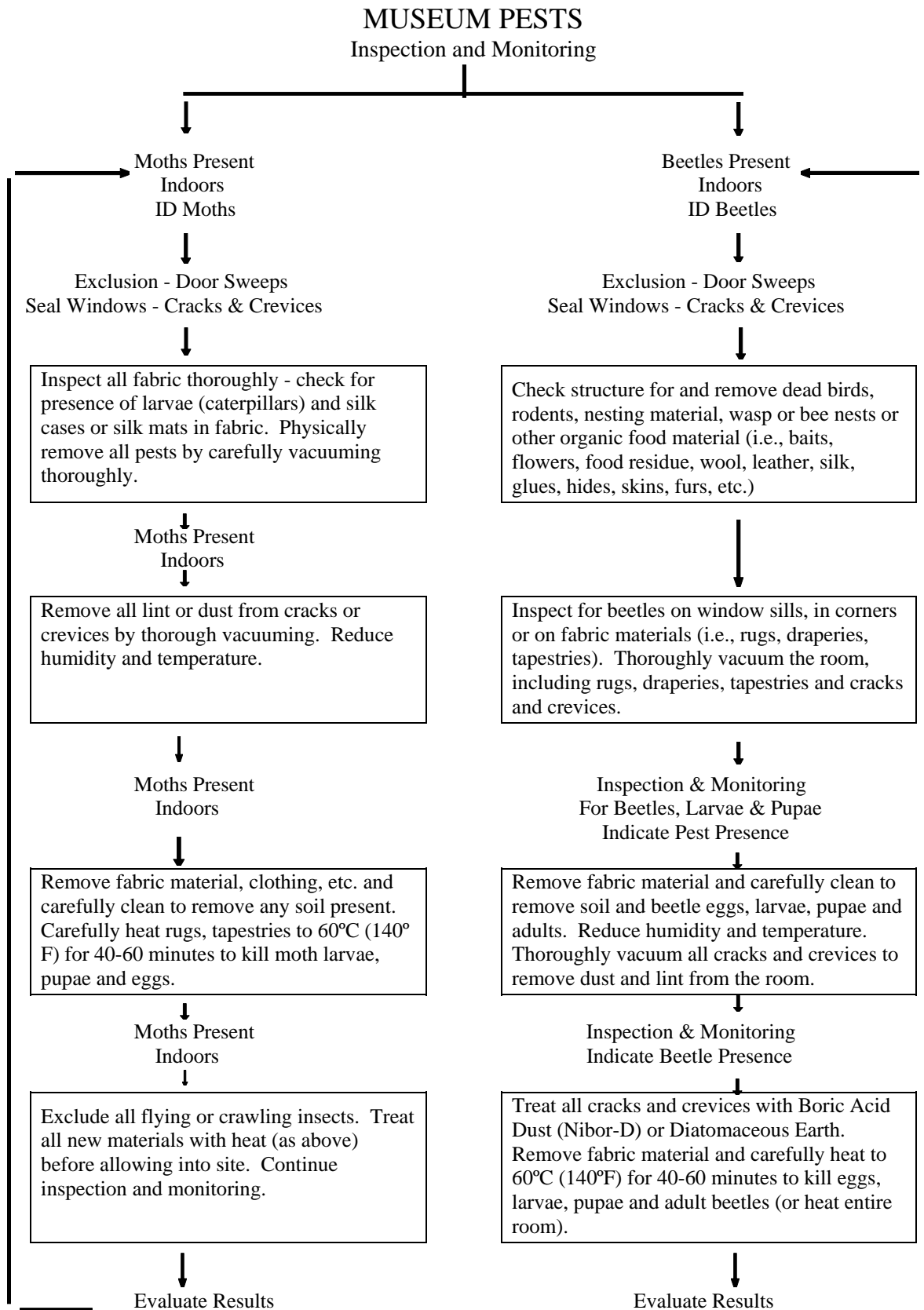
Hide Beetle
Dermestes frischii



Spider Beetles
Mezium americanum (laporte)



Larder Beetle
Dermestes lardarius L.



PSOCIDS - BOOKLICE (Worldwide)

(*Liposcelis corrodon*) but also many other species. Cosmopolitan distribution.

DESCRIPTION

Psocids or Booklice are small (.1 - .3 cm [1/25 – 1/8 in] long), opaque to white in color, soft-bodied insects with four wings, or only wing buds in adults.



Psocids

The insects can over winter in the egg stage. After eggs hatch through gradual metamorphosis, booklice attain maturity in around one to two months and can live up to three months. Moist conditions enhance growth and longevity and booklice are most common in structures during spring and summer. Large populations can suddenly appear under high humidity or moisture conditions. Psocids may also be found in bird or mammal nests, moist grain or other starchy plant material.

DAMAGE

Booklice damage paper products, bindings and eat paste, glue or anything supporting mildew. Psocids generally feed upon microscopic molds. They often infest damp, moldy books, feeding on both the mold and starch in glues. They also will infest dried plants in herbaria, insect collections, and furniture stuffed with flax, hemp, jute or Spanish moss. The presence of booklice is an indicator of moisture problems.

MONITORING

Sticky traps may not be attractive to Psocids except in large populations. Direct observation of susceptible materials may be necessary. The presence of mold, fungi or other indications of high humidity or moisture are clues to conditions favorable to psocids. If mold is present, look for psocids!

BIOLOGY

Outdoors, booklice live under tree bark and feed on fungi; they lay eggs during fall and spring. Indoors, booklice feed on mold and mildew and under proper conditions breeding and development can continue indefinitely. Booklice are most commonly found in dark cracks and crevices. Females of at least one species can reproduce parthenogenetically and produce from 120 to 450 eggs per season in clutches that average about 20 to 50 eggs each, depending on temperature conditions.

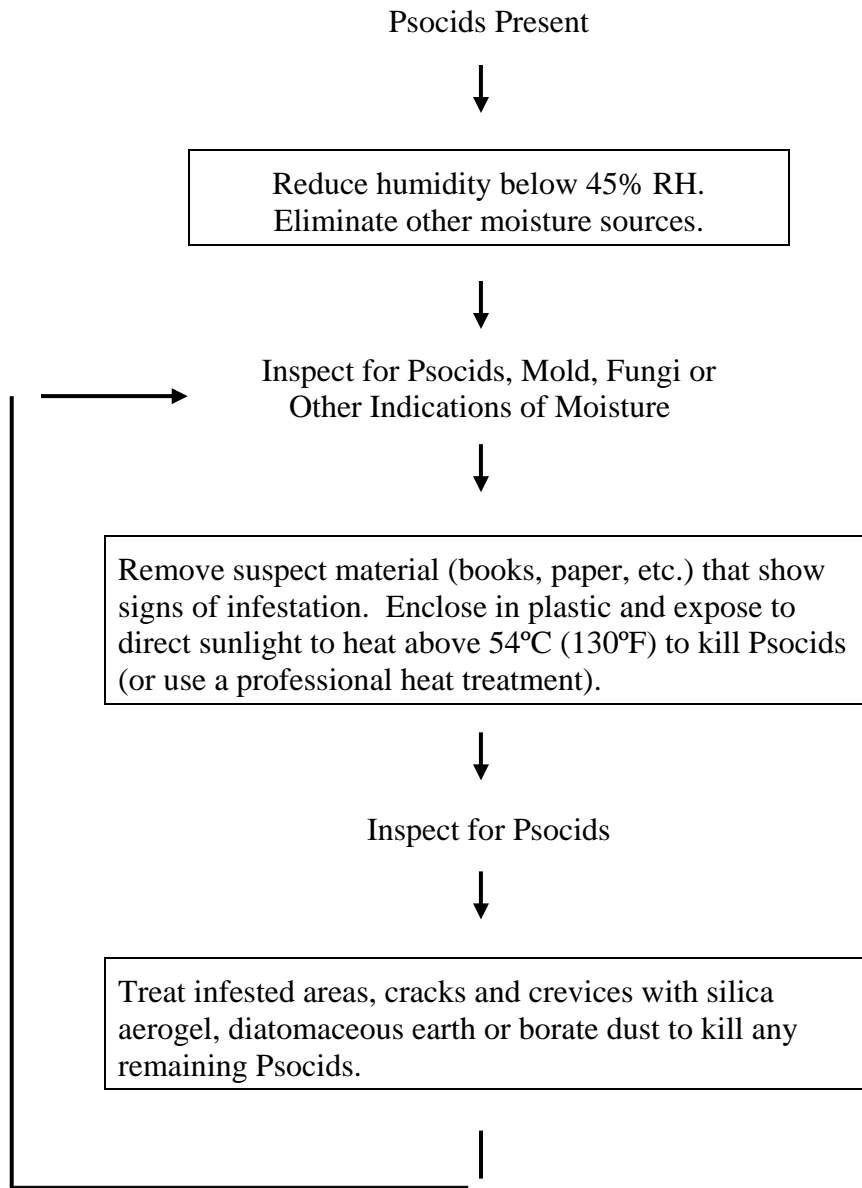


Winged Psocid

MANAGEMENT

Psocids are best managed by reducing the humidity below 45%. This may take some time, but eventually all psocids will desiccate and die. Removing other moisture sources will also help. For infested books or other materials, placing them in a clear plastic bag and exposing them to direct sunlight to heat the interior about 54°C (130°F) will kill localized infestations. Diatomaceous earth, silica aerogel or borate dusts will manage psocids.

PSOCIDS - BOOKLICE



SILVERFISH AND FIREBRATS (Worldwide)



Silverfish

Silverfish (*Lepisma saccharina* L), are wingless, flat and carrot-shaped insects, about 1.27 cm (1/2 in) long, and covered with a sheen of silvery scales. They have two long antennae and possess three long, slender filaments that project rearward from the abdomen. Silverfish prefer temperatures between 21 - 27°C (70 – 81 °F), and high humidity. Adults may live from two to eight years, and can survive as long as a year without food. Silverfish feed on starches like flour, glue, paste, and textile and paper sizing, but they can also digest cellulose.

Silverfish populations build up around materials upon which they feed, such as corrugated cardboard boxes in damp basements, and on insulation, glue, and stored books. Silverfish lay eggs in cracks over an extended period of time, which hatch in about 30 days. Immatures reach maturity in three to four months. Their feeding leaves irregular, yellow-stained holes in textiles and paper, damaged surfaces on corrugated cardboard, and irregular chewed areas on cloth-bound books. Damaged materials often have dark fungus growing on them supported by humidity and insect fecal pellets. Large populations of silverfish spread into other humid areas within the building from basements and wall voids penetrated by pipe ducts and electrical conduits.

Firebrats (*Thermobia domestica* [Packard]) are similar insects but not silver-colored, rather mottled dark gray and dull yellow. Their size, shape, and appendages very much resemble silverfish, but firebrats prefer decidedly higher temperatures and surroundings, to 32°C (90°F) or above. Firebrats are commonly found in furnace rooms, steam-pipe tunnels, hot bathrooms, and partition walls of water-heater rooms. The firebrat female lays one to three batches of average 50 eggs per batch depositing them in cracks. It takes two to four months from egg to adult under optimum conditions (32 - 38°C [90 – 100°F] with 76 – 85% relative humidity). Firebrats feed on carbohydrates and proteins such as bond paper, linen, cotton, silk, dried beef, etc.



Firebrat

HAZARDS OF INFESTATION

Silverfish and firebrats are destructive to books, paper, fabrics, and may contaminate foods. These insects are often found in libraries, book shelves and areas where old books and papers are stored.

INSPECTION AND MONITORING

In a quarantine area, thoroughly inspect incoming goods, furniture, books and other materials for the presence of silverfish or firebrats. Remove or treat any items that are infested.

Conduct a thorough inspection for the presence of pests, moisture, food sources, clutter, cracks, crevices and other openings. Inspect water heater closets, utility rooms and areas of high humidity and temperature. Bookcases and books are especially attractive to these pests.

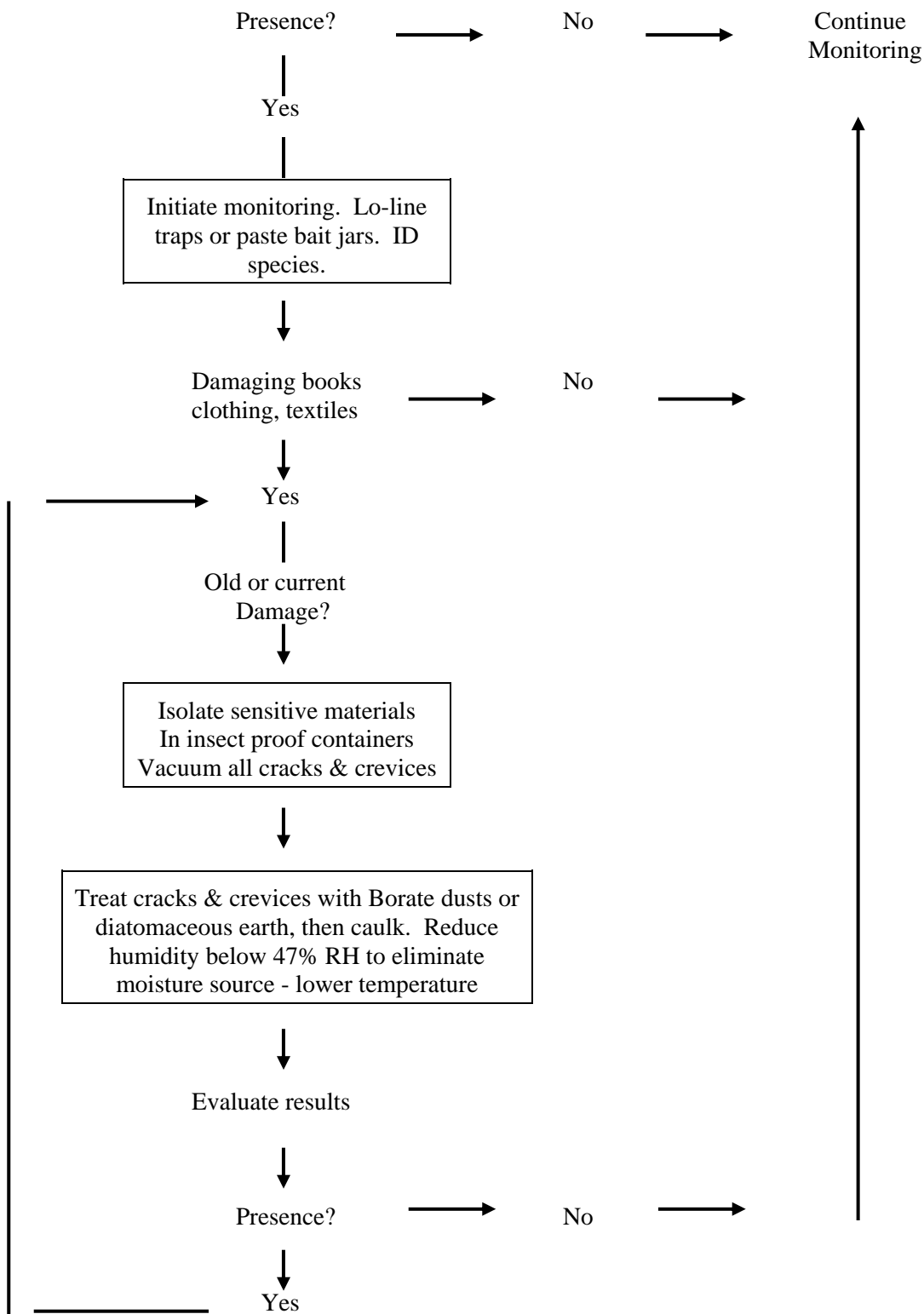
MANAGEMENT

Exclusion: For pests the size of silverfish or firebrats to be excluded, use caulk, Stuf-Fit, oakum, weather stripping, door sweeps, screens and other repair approaches. Once done, excluding silverfish and firebrats is usually passive and permanent.

Sanitation: It doesn't take much organic material to feed silverfish or firebrats. Water in any form, condensation, leaks or moisture in potted plants, etc., should be eliminated. Silverfish and firebrats like to be in an area where they feel safe – in between things. Clutter that builds up in corners, on cabinets, shelves or on the floor becomes harborage for firebrats, silverfish that can attack and ruin irreplaceable historic artifacts. Sanitation is active and must be conducted on a daily basis.

Habitat modification: Eliminate food, water and shelter. Other means are raising or lowering temperatures or reducing humidity to levels intolerable by pests, and increasing lighting. Habitat modification is relatively passive and semi-permanent.

SILVERFISH AND FIREBRATS



ASIAN LADY BEETLE *Harmonia axyridis* (Pallas)

The Asian lady beetle, *Harmonia axyridis* (Pallas) was introduced into the United States between 1910 and 1970 unsuccessfully (no survival). After years without a sighting, the beetle was seen in Louisiana in 1988, apparently from an accidental introduction in a freighter from Asia to New Orleans. Since that time, the Asian lady beetle has spread throughout the northeast from Florida to Quebec, and west to Missouri and Texas. It has also been reported in Colorado, Oregon, Washington, and British Columbia, Canada.

The Asian lady beetle is a voracious feeder on aphids, scale and other soft-bodied insect pests. Both the adult and larval forms of the beetle are predators on soft-bodied prey. In its native habitat (most of Asia), it tends to overwinter in larger congregations in white cliffs, cracks, crevices and other voids. Here in the United States, the Asian lady beetle tends to aggregate in large numbers in homes, structures and other human-constructed or occupied sites. When they overwinter in a historic structure which contains valuable artifacts, their presence may pose a hazard. Large numbers of beetles in structures over a harsh winter causes a number of the beetles to die. It could be a few or many. The dead beetles can become a food source for dermestid beetle larvae. Dermestid beetle larvae or adults in a historic site may become a major threat for organic material in the collection, including furs, woolens, sinew, cotton, silk or other material on display.



Asian Lady Beetles



Dead *Harmonia* & Dermestid Larvae

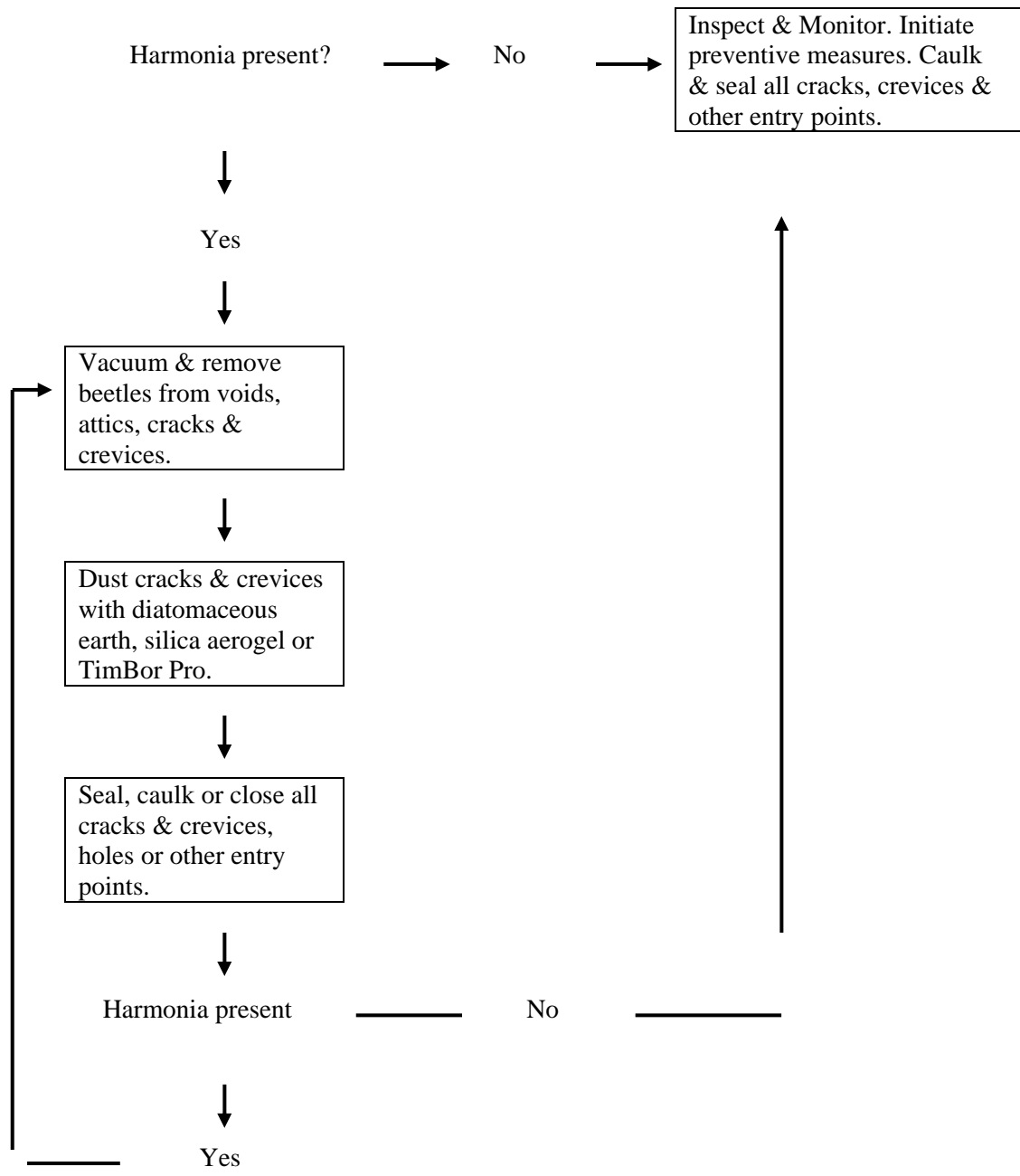
The first line of defense against the beetle is to fill all cracks, crevices, holes or other entry points into the structure. A hole as small as .53 cm (7/32 in) wide can allow beetle access to the inside of the structure.

The second line of defense is sanitation. The beetles like to use clutter in which to overwinter. Elimination of clutter will reduce the areas where the overwintering beetles congregate.

The third means of managing the beetles once they are in the structure is to use a vacuum to remove them in large numbers. Black light (ultraviolet) traps with a sticky glue board to collect the beetles attracted to the light are also useful. The traps should be checked periodically and the glue boards replaced when full.

Vacuum the joists, beams and other accessible voids in the attics each spring and late fall.

ASIAN LADY BEETLE CHART



HOUSE CRICKET (*Acheta domesticus* [Linnaeus]) (Worldwide)

House cricket adults are 1.91 – 2.54 cm (3/4 – 1 in) long and have a light-colored head marked with three dark cross bands, yellowish-brown to straw-colored body, long and thin antennae, and heavy mandibles. House crickets fly but also have large rear jumping legs like a grasshopper. Crickets are nocturnal insects that enter structures in spring or before winter. They are attracted to shelter, light, moisture, and warmth. House crickets are mainly attracted to warm areas

around stoves, fireplaces, and furnaces, but they can also be found throughout the structure.



Nymph & Adult House Crickets

Incessant nocturnal chirping by the male makes this a nuisance pest. Outside, house crickets live in compost piles, debris, and garbage dumps. Usually there is one generation per year. Eggs laid in sandy soil during fall hatch in late spring. Nymphs often enter structures under doors or through cracks and voids and complete their life cycle indoors, where they develop all year and lay eggs in cracks. Nymphs mature in mid- to late-summer.

Outside, house crickets feed on plants and other insects. Inside, their diet is more diverse: they feed in early evening on bread crumbs, fruits, vegetables, liquids, paper (such as soiled newsprint), clothing, rubber, silk, wool, linen, rayon, fur, feathers, meat and meat products, dead insects, and leather. House crickets contaminate food by walking over it.

INSPECTION AND MONITORING

Outside: Inspect for the presence of house crickets near the structure. Also check for moisture near the building, and for organic material (mulch, leaves, etc.) that provides harborage and food. Look for cracks, crevices and other openings (drains, pipes, vents) into the structure that provide entry for house crickets.

Inside: Conduct an inspection for the presence of moisture, food sources, clutter, cracks, crevices and other openings. Place and check WEEKLY sticky trap monitoring devices at floor/wall junctions and other likely or critical areas where house crickets may occur.

MANAGEMENT

Reduce indoor humidity and temperature if possible. Eliminate all water sources. Thoroughly clean to remove all available organic material. Treat cracks and crevices with borates and/or diatomaceous earth. Sticky traps can remove adults and nymphs. Install tight-fitting door sweeps on all outside doors. Caulk cracks, crevices and other access points.

FIELD CRICKETS (*Gryllus spp.*) (North America)

Field crickets are common pests attracted indoors by light; however, once inside, they die before early winter because they cannot adapt to indoor conditions. Adults are 1.27 – 2.54 cm (1/2 to 1



Field Cricket

in) long and look very similar to house crickets, except that field crickets are usually black to dark brown in color, and have brown wings, a shiny head, and antennae much longer than the body. Males have two spear-like appendages at the tip of the abdomen. Females have three similar appendages.

The field cricket also flies and jumps. In northern parts of the United States, eggs deposited in the ground are the overwintering stage for most field crickets. The small remainder pass the winter as half-grown nymphs under leaves, trash, and debris. There

is only one generation per year. Females lay 150 to 400 eggs about .64 – 2.54 cm (1/4 – 1 in) deep in the soil in late August to September. Eggs hatch in May to June and nymphs develop in nine to 15 weeks. Adults are only found outside from late July until the first hard freeze. Field crickets migrate into structures during fall, when populations are large, or as vegetation dries up.

Indoors, field crickets are attracted to such warm, dark areas as water-heater closets and large appliances. They are usually found in basements and ground-floor levels where they feed on human food, debris, and clothing. Field crickets do not live long indoors. However, they can cause damage to cotton, wool, linen, silk, synthetics, and leather and fur items.

INSPECTION AND MONITORING

Outside: Inspect for the presence of field crickets near the structure. Also check for moisture near the building and for organic material (mulch, leaves, etc.) that provides harborage and food.

Inside: Conduct a thorough inspection for the presence of crickets, moisture, food sources, clutter, cracks, crevices and other openings. Place and check WEEKLY sticky trap monitoring devices at floor/wall junctions and other likely or critical areas where field crickets may occur. Inspect water heater closets, utility rooms and areas of high humidity and temperature.

MANAGEMENT

Reduce indoor humidity and temperature if possible. Eliminate all water sources. Thoroughly clean to remove all available organic material. Treat cracks and crevices with borates and/or diatomaceous earth. Sticky traps can remove adults and nymphs. Install tight-fitting door sweeps on all outside doors. Caulk cracks, crevices and other access points.

CAVE OR CAMEL CRICKET (*Ceuthophilus spp.*) (Worldwide)

Cave or camel cricket populations build up indoors during fall, when large numbers of these insects move under doors and through cracks, seeking dark, cool, damp areas in crawlspaces,



Cave or Camel Cricket

basements, utility rooms, garages, and outdoor sheds.

They are rarely found in occupied spaces. Their natural habitat is outside, where camel crickets live under stones and logs or in animal burrows. Camel crickets have a rounded, hump-backed appearance with a head bent downwards. They are light brown in color with darker brown bands and markings. Camel crickets are easily identified by their long antennae and long and large jumping hind legs. They are wingless, don't chirp, and are not attracted to light. Most importantly, camel crickets serve as a warning or indicator of excessive moisture

problems. Camel crickets can feed on cotton, linen or other cloth material.

INSPECTION AND MONITORING

Outside: Inspect for the presence of cave crickets near the structure. Also check for moisture near the building and for organic material (mulch, leaves, etc.) that provides harborage and food. Look for cracks, crevices and other openings (drains, pipes, vents) into the structure that provide entry for pests.

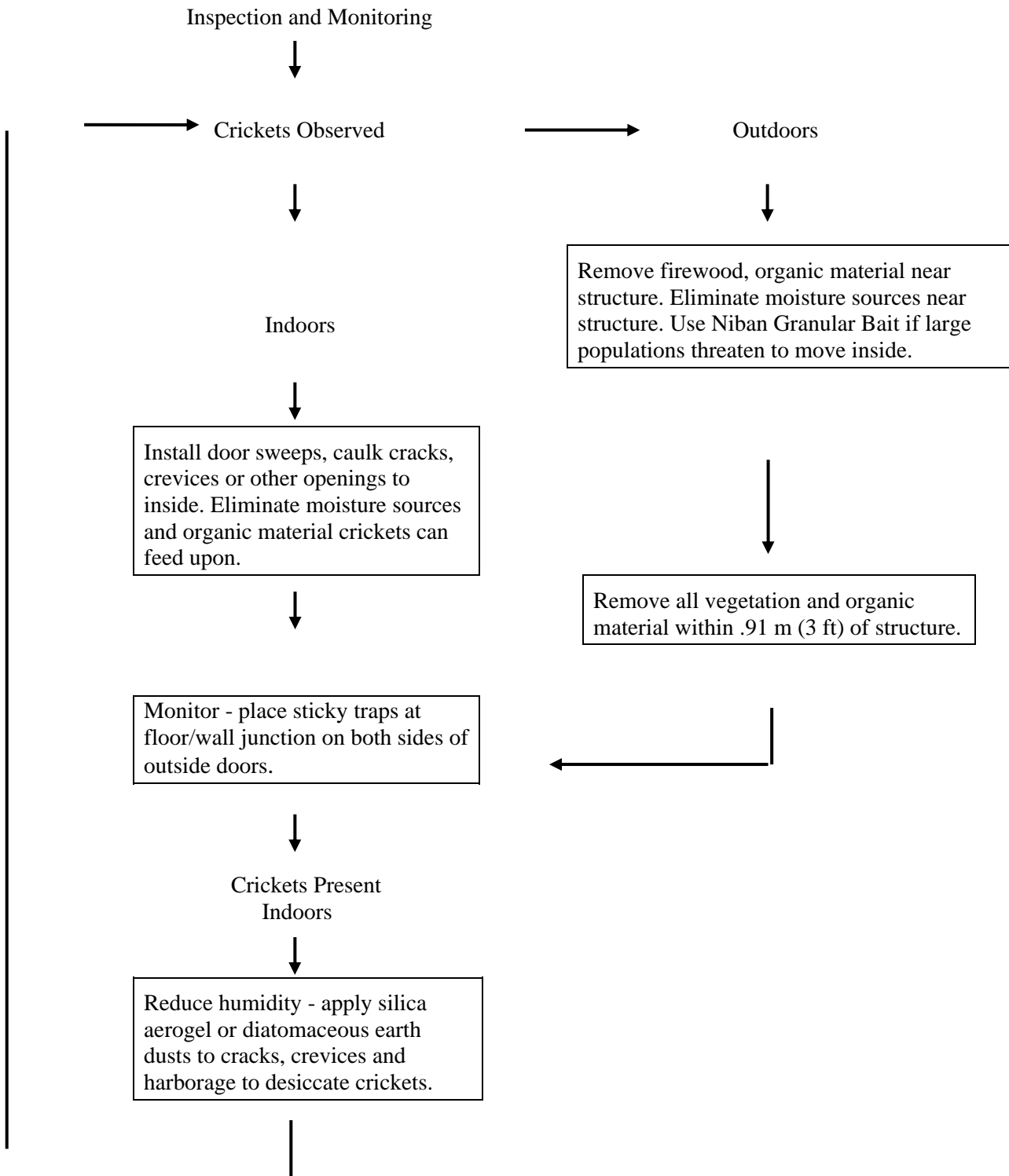
Inside: Conduct a thorough inspection for the presence of crickets, moisture, food sources, clutter, cracks, crevices and other openings. Place and check WEEKLY sticky trap monitoring devices at floor/wall junctions and other likely or critical areas where cave crickets may occur. Inspect water heater closets, utility rooms and areas of high humidity.

MANAGEMENT

Outside: Remove all organic material (mulch, leaves, etc.) from within .91 m (3 ft) of the structure (replace with a 1.91 – 2.54 cm [3/4 – 1 in] mulch or gravel) and eliminate moisture and standing water in this area. Install effective door sweeps on all outside doors and eliminate other entry points into the structure.

Inside: Reduce humidity levels and eliminate leaks and other water sources. Keep corridors, offices, exhibits and storage spaces clean (no organic material available to the pest). Eliminate clutter, caulk cracks, crevices and close hiding places. Dust cricket harborage with diatomaceous earth (DE) or borate insecticide.

CRICKETS



APPENDICES

APPENDIX I

PEST PROFILES

STRUCTURAL PESTS

POWDERPOST BEETLES



Powderpost Beetle



Powderpost Beetle Damage



Powderpost Beetle Larvae

The first group is known as lyctid powderpost beetles. Lyctids are small, reddish-brown to black beetles about .3 - .64 cm (1/8 - 1/4 in) long, whose life cycle requires about a year or less and takes place entirely within wood, except for mating. They only attack the sapwood of hardwoods having large pores, such as oak, hickory, ash, walnut, pecan and many tropical hardwoods. They attack both new and seasoned wood, so they may occur either in structural members or in paneling, furniture and flooring.

Their damage appears when larvae construct numerous galleries, about .15 cm (1/16 in) in diameter, throughout the wood. Exit holes of .08 - .15 cm (1/32 - 1/16 in) in diameter on the wood surface (made as newly-emerged adult beetles escape from the wood), coupled with fine sawdust-like frass, may be the only evidence that lyctid beetles are at work. The frass may collect below the infested wood on spider webs, or it may fall out when slightly tapping the wood. The interior of wood may be so riddled with galleries that the remaining structure is only a veneer of surface wood. Replacement or removal of panels may be the best method if the infestation is not structural. However, if structural members are involved, the treatment depends on the extent of the infestation. If only exposed timbers are involved, a Borate insecticide may be the best treatment. However, if the extent of the infestation is uncertain, one should carefully examine and probe-delineate the infestation for treatment. Heat may then be the treatment of choice.

Anobiid beetles, also known as death-watch or furniture beetles, belong to the powderpost beetle group. The adult beetles are also .3 - .64 cm (1/8 - 1/4 in) in length and reddish-brown to black in color. However, the adult beetles are rarely seen, and it is the fine frass, pellets and exit holes (.15 - .3 cm [1/16 - 1/8 in] in diameter) which indicate their presence. Their damage includes boring in the sapwood of both hardwoods and softwoods, and reinfestation of seasoned wood if conditions are favorable. Attacks often begin in attics or in poorly ventilated crawl spaces and then spread to other parts of the structures.



Death-watch Beetle & Damage

If the frass is yellowed or partially caked on the surface where it lies, the infestation is probably old or already managed. It may take ten years or more for infestations to become significant enough to be noticed. At this point, both large numbers of exit holes and large quantities of whitish frass are observable. Once the infestation is noticed, management, as with lyctids, depends on the extent of the infestation. The options are essentially the same as those listed for management of lyctid beetles.

BOSTRICHID (false) POWDERPOST BEETLES

The size of various species ranges from .64 cm (1/4 in) (most common species) to 5.08 cm (2 in) (uncommon species). All of the species are elongated, cylindrical, compact beetles with a flat-headed appearance in profile. The larvae are whitish, similar to other powderpost beetle larvae. Their life cycle is relatively short (about a year).



Bostrichid Beetles

There are several species in this group. Among the well-known species are the bamboo borer, the red-shouldered shot-hole borer, the oriental wood borer, the black polycaon, and the lead cable borer. Some of the species are pests of stored products such as grains.

Although this group reinfests wood, it rarely does severe economic damage. Most damage noticed in construction timbers occurs before curing while moisture content of the wood is high. An exception is bamboo and weakened (from moisture or other damage) structural timber, in which considerable

damage may occur. The appearance of frass is similar to that of lyctids, except that it often forms small cakes or clumps. However, unlike the lyctid powderpost beetles, exit holes are free of frass and are .08 - .94 cm (1/32 - 3/8 in) in diameter, depending upon species.

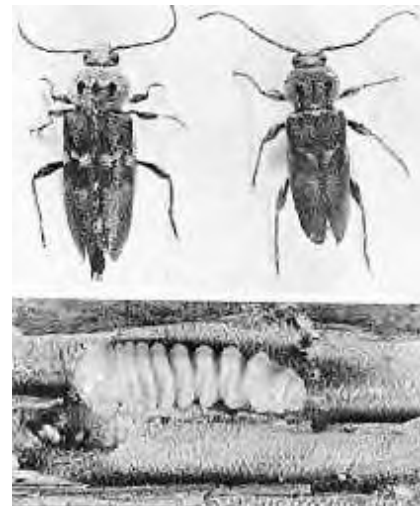
OLD HOUSE BORERS

This pest, a native of northern Africa, spread to the U.S. through Europe, and is now ranked second to termites as a pest of seasoned wood in structures. Its distribution is primarily along the east coast, with occasional findings in the other states east of the Mississippi River. The old house borer, *Hylotrupes bajulus*, is a large brownish-black, slightly flattened beetle that ranges from 1.57 – 2.54 cm (5/8 – 1 in) in length. It is a long-horned beetle and has two prominent bumps on the prothorax. The larvae are also large (up to 3.18 cm [1 1/4 in] long) and homeowners may hear them making gnawing sounds (clicking). Unfortunately, evidence of their presence, bulging of the surface wood, only occurs when larvae are near maturity. Eggs are placed in small cracks or in the joints between floor joists and other structures.

The life cycle in the northeastern states may take six to eight years or longer to complete, while in the southeast, the life cycle takes only three to five years. Adults may remain in galleries for up to ten months before emerging. Once emerged, usually in June or July, they live just a matter of weeks before they mate, lay eggs and die.

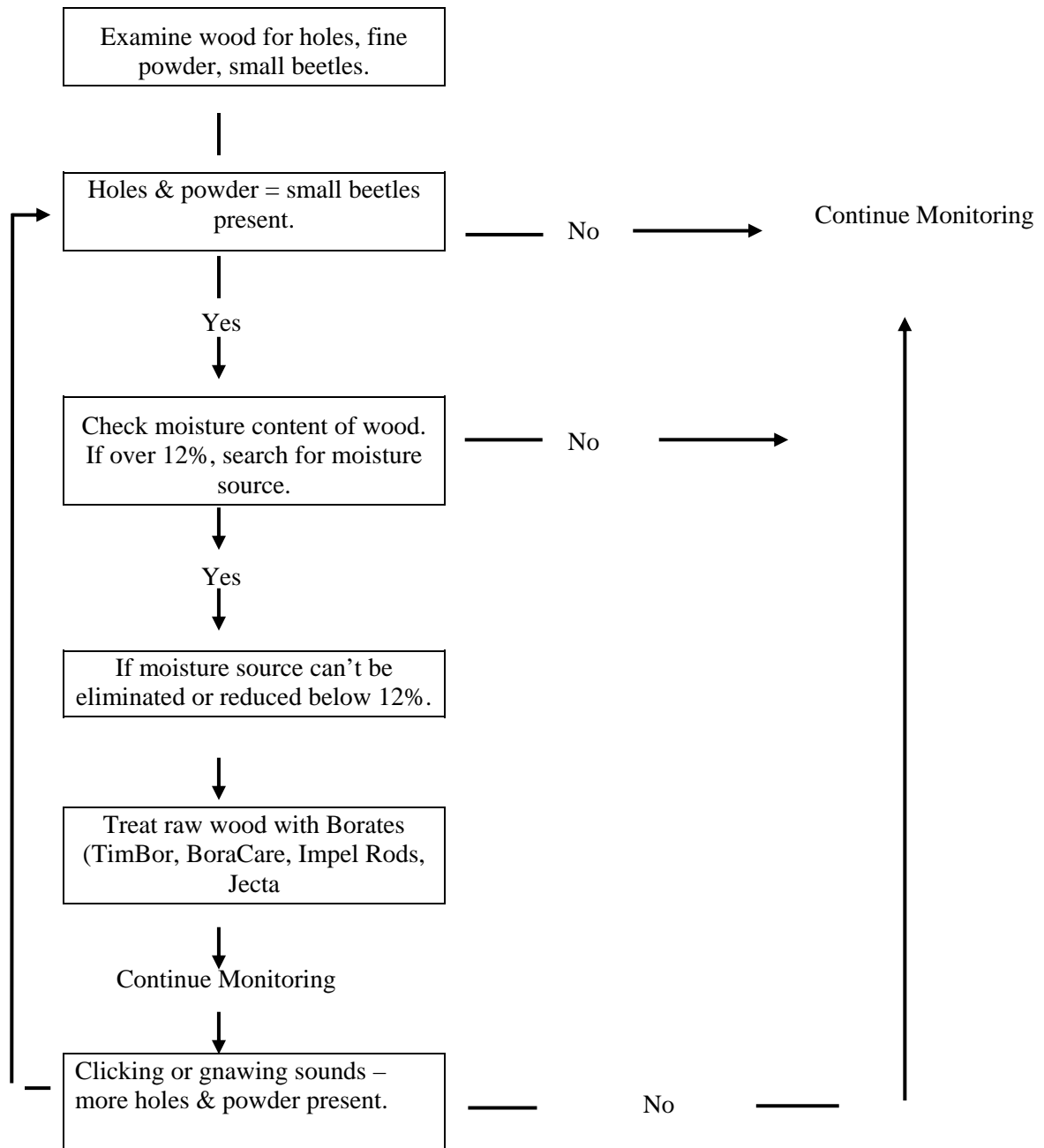
The old-house borer usually occurs in new, not old wood, as the name implies. However, it usually escapes notice until years after the completion of the structure. Infestation by a second generation of borers occurs rarely in well-ventilated, centrally heated structures. When such reinfestation occurs, there may be overlapping generations of borers in the structure for many years.

Favorite attack sites include attic framing, floor joists and wood studs. The larvae may reduce the sapwood area of these timbers to mere powdery frass. Luckily, the damage is localized. The fecal pellets are rod-like and crumble easily. The most characteristic feature of infestation is the damage, which is striking because of the size (up to .94 cm [3/8 in] in diameter), shape (oval) and rippled appearance in the galleries. Just prior to emergence, larvae may create bulging in the wood. Exit holes are also oval in shape and surrounded by frass and feces.



Old House Borer

WOOD DESTROYING BEETLES



NOTE: Holes and powdered frass will not disappear. If holes increase in number and jeopardize structural integrity of building, replace damaged wood with borate-treated wood.

CARPENTER ANTS

Carpenter ants (*Camponotus spp.*) are social insects which live in small to occasionally large nests. Unlike other ants found in structures, they excavate wood and build nests in it, but they do not eat the wood. They occur throughout the contiguous 48 states and Hawaii, especially in the Pacific Northwest and the northeastern states. Carpenter ants are nocturnal forest-dwelling insects that, in nature, live in dead and rotting logs and trees, under stones and in leaf litter at elevations up to 9,000 feet.



Carpenter Ant Queen & Workers

Carpenter ant workers are large (.45 – 1.57 cm [3/16 – 5/8 in] long), usually black (although not invariably so) and can inflict painful stings. The waist between the thorax and abdomen, unlike most structure-infesting ants,

has a single node, and the overall profile is continuous. The queen is up to 1.42 cm (9/16 in) in length and, as with the male, may bear wings during the swarming season.

The larvae are white and legless and are fed by the workers. Pupae are also white and often are carried about by workers if the colony is disturbed. The foods of adults are sugar and sometimes proteins found in or around a site. Adult ants often feed on aphid honeydew found on plants infested with large populations of aphids. Winged adults emerge from March to July, depending upon location, and establish a nest in moist wood or a cavity adjacent to wood. The colony grows over a three-to-six year period before it matures. Winged swarmers appear in the nest in the late fall, but do not fly to start new colonies until the following spring.



Eggs, Larvae & Pupae

Swarming begins during the first warm or wet days of the year. New housing built on cleared woodlots that previously supported carpenter ants is generally the most troubled. Nests are found in water-rotted wood under shower stalls, under leaking roof-valley downspouts, in window sills where water accumulates, in poorly ventilated areas, and sometimes under insulation in attics. The larger and more long-lived a carpenter ant colony is, the greater is the structural damage.

Outside, carpenter ant workers forage for such foods as honeydew, insects and ripe fruit juices. Ants are not as active during winter. Carpenter ants often move into structures during fall to forage for sweets after plant aphids disappear. Those that have invaded structures seek out sweets, meats, fruit juices and moist kitchen refuse. Since carpenter ants are usually not very active indoors during winter, an occupant's ant complaint during winter is a sure sign of an



Carpenter Ant Galleries

indoor nest. Carpenter ants usually leave structures for the outside during summer. Carpenter ant nests consist of galleries that normally run with the grain of sapwood and have large interconnections which are free of wood shavings, mud and feces, and appear smooth and sanded.

Wood shavings and frass are thrown out of the nest through slit-like exit holes in the surface. Small piles of sawdust-like material may build up below tunnels. During summer months, ants are active at night when chewing sounds are audible.

The nest location may not necessarily be in the building; it may be a hundred feet or more away in a stump or decaying log.

Access to buildings is through ground connection, utility wires or branches touching the building. Since moisture is required to sustain a colony for any length of time, a carpenter ant nest indoors is normally near a moisture-laden area. Indoor nest locations may be in door and window frames, wall voids, roof/ceiling of flat deck porches and hollow porch columns, or behind fascia boards.

Carpenter ants are multi-queened and usually excavate wood previously decayed or damaged by other agents. They generally forage in humid atmospheres (under debris, in damp crawl spaces or in vegetation on building walls) where they find softened wood. Carpenter ants are not thought to be able to start tunnels in wood dryer than 12% moisture content, and some species even have high humidity requirements for the nest.

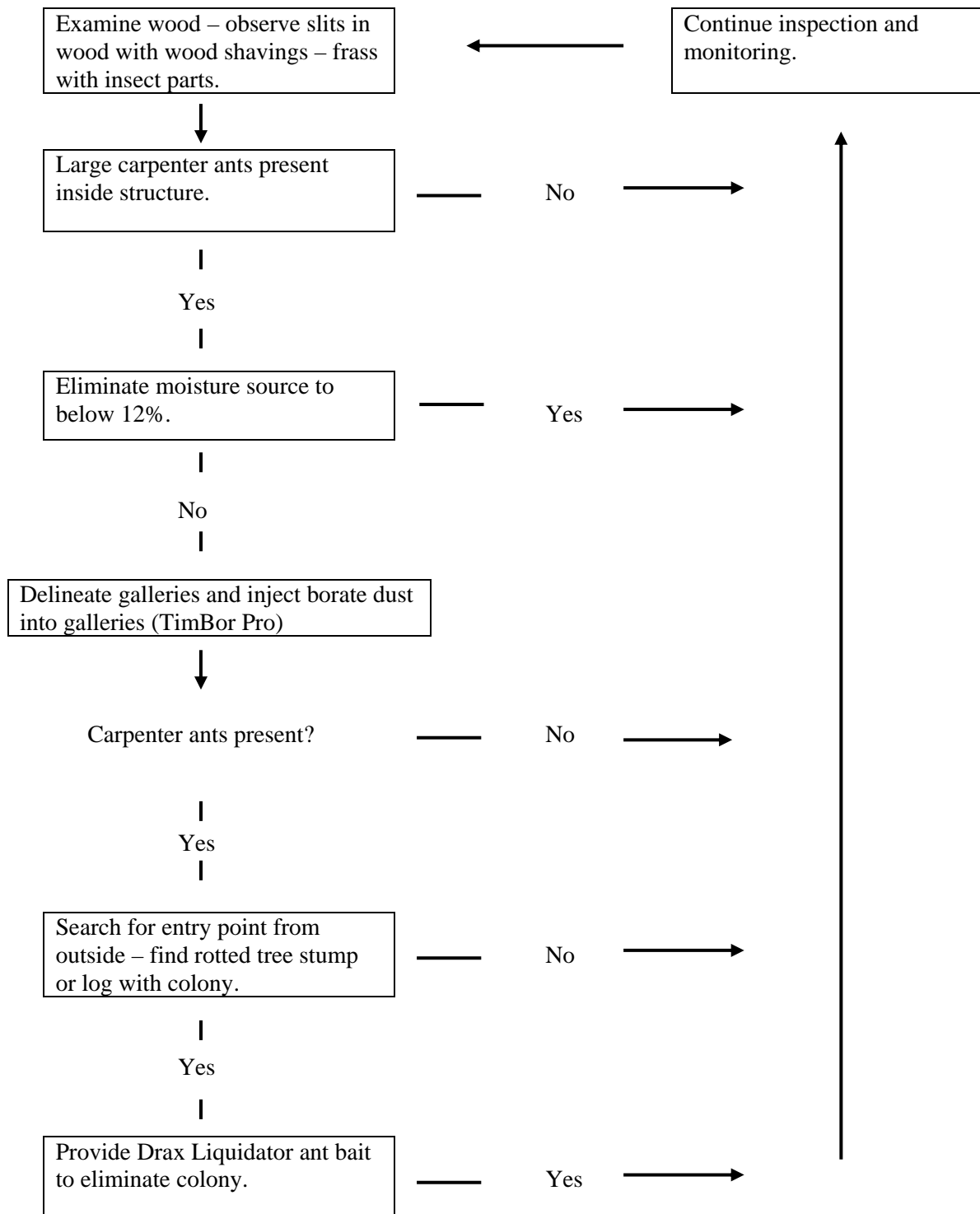
DAMAGE, PREVENTION AND MANAGEMENT

If ignored for many years, structural damage caused by carpenter ants may be extensive and severe. The damage rarely causes structural failure unless the wood is stressed by strong winds or heavy furniture placed on the infested timber.

Prevention methods include eliminating moisture sources in the house, breaking connections to the outside, ensuring good ventilation to crawl spaces, sealing all gaps in wood members, removing wood debris from around the structure, and using borate-treated or pressure-treated lumber in areas subject to moisture.

The most difficult part of treatment is locating the nest, without which the problem cannot be eliminated. If the nest is outside the building, the infested log, stump or other wood item should either be eliminated or removed. Inside the building, the infested areas may be sprayed or dusted with a borate insecticide. In inaccessible areas, wood may require drilling and injection with the pesticide. Chemicals of choice include disodium octaborate tetrahydrate (DOT), silica gel or diatomaceous earth. Some slow-acting baits such as Drax Liquidator may be effective.

CARPENTER ANTS



CARPENTER BEES

Carpenter bees are smooth and shiny solitary bees with a mostly black abdomen. Carpenter bees are similar in appearance to bumble bees, but lack hair on the dorsal side of the abdomen, except on the first segment.



Carpenter Bee

They bore into wood to make a tunnel of cells provisioned with pollen in which they lay eggs and to supply developing young. The tunnel is divided into cells where the individual larvae develop. The tunnels bored by carpenter bees may cause structural damage to buildings where they nest. Typical nesting sites in a structure include fascia, window trim, eave areas, rafters, wood shingles, wood siding, patio furniture and exterior wood trim. Although many different types of wood are selected for nesting sites, softer woods are preferred. Additional damage to the structure can be made by woodpeckers as they bore into the wood to feed on the developing larvae.

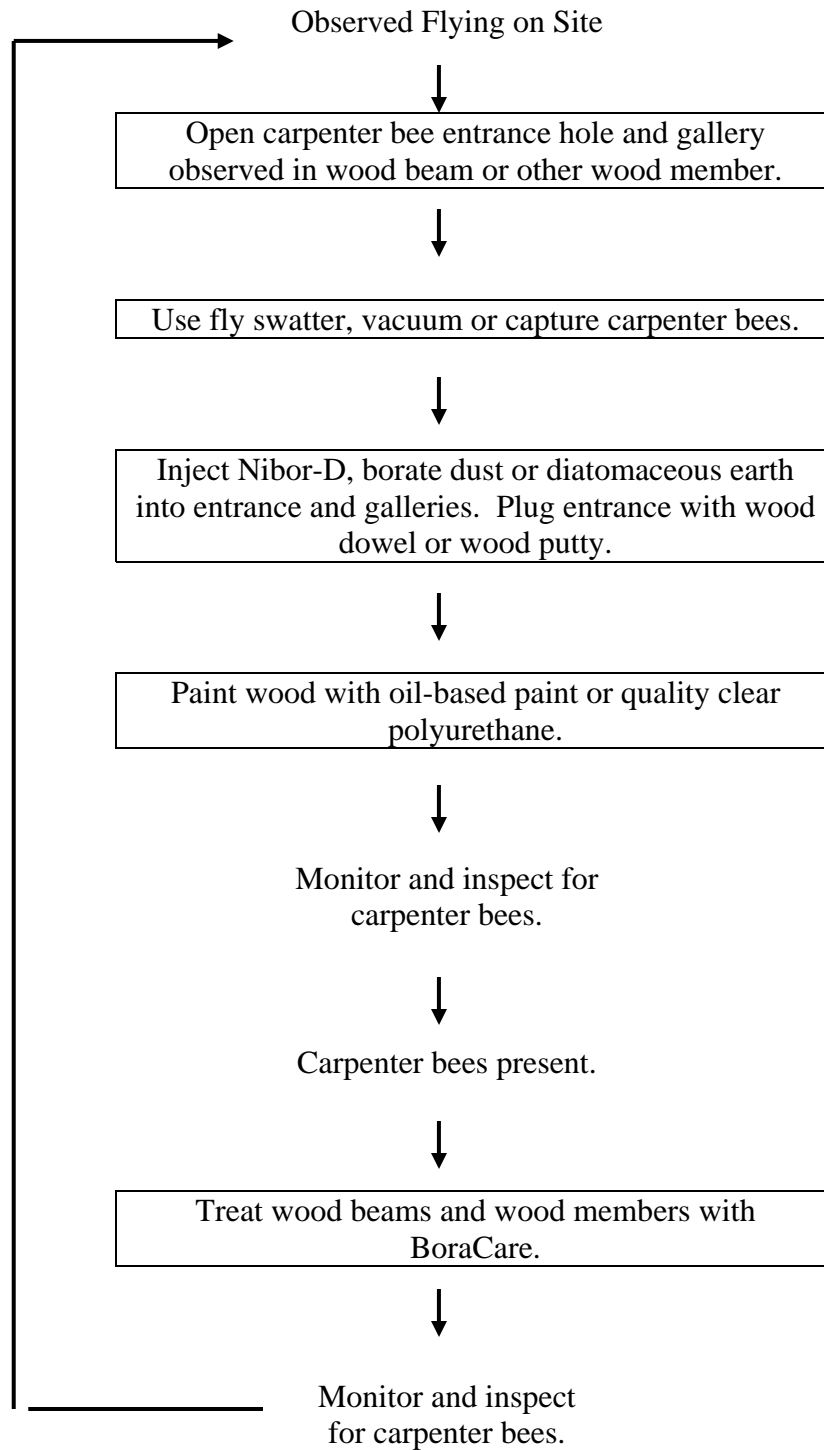
INSPECTION AND MONITORING

Inspect the bottom edges of exterior exposed wood for 1.27 cm (1/2 in) diameter round holes drilled vertically. These are carved by the female carpenter bee forming right angle branches of cells. The male flies aggressively around to protect her while she works. If the hole is sealed, the nest is complete with cells, pollen provisions and eggs or overwintering developing larvae. Adult carpenter bees will emerge in the spring. Only the female carpenter bee can sting. Adult carpenter bees feed on pollen and honey.

MANAGEMENT

Good quality oil-based paint on the wood (especially bottom edges of exposed beams, fascia, etc.) will prevent and exclude the female bee from constructing the nest. If the nest is in the process of being carved into the wood, dusting inside the hole with diatomaceous earth, TimBor Pro or other low-risk dust pesticide will deter further damage and kill the developing eggs or larvae. Woodpeckers will attack live larvae inside the cells by boring through the wood.

CARPENTER BEES



ARGENTINE ANT (*Iridomyrmex humilis* [Mayr])

The Argentine ant, native to South America, now widely ranges throughout the United States and the world. This highly adaptable ant is the most common of the trailing ant species that invade structures in search of foods. Its natural range is only limited by cold temperatures. The Argentine ant has one node on the petiole, a musty odor when crushed, carries no known diseases, and has no public-health importance. It is very aggressive, has no natural enemies, and drives other ants away. Although the Argentine ant bites, it doesn't normally attack human beings.



Argentine Ant

Argentine ant nests are usually located in moist areas around refuse piles, under stones or concrete, rotten wood, bird nests, beehives, and in tree holes. In winter, colonies move deep into the soil. Although it seldom nests indoors, nests are sometimes found in buildings near heat sources. This ant is multi-queened, very prolific, and supports large colonies (thousands to tens of thousands) but seldom swarms, because breeding takes place in the nest. The

Argentine ant is a major pest in structures, and is commonly seen near baseboards, windows, and water pipes, seeking food or to escape too-wet or too-dry outdoor conditions. It is often found on potted plants because it tends scales, mealy bugs and aphids, from which it obtains honeydew. Indoors they feed on meats, sweets, dairy products, eggs, fats and oils, but prefer sweets. Argentine ants also feed on termites, other ants, fly larvae, and cockroaches. Argentine ant eggs hatch in 28 days, the larval stage lasts 31 days, the pupal stage lasts 15 days, and complete life cycle is 78 days.

PHAROAH ANT (*Monomorium pharaonis* L.)

Originally from the African tropics, the pharaoh ant is a trailing species with two nodes on the petiole, twelve segments in the antennae, and a three-segmented antennal club. Its color is yellow-to-red, and the pharaoh ant is .25 – .15 cm (1/10 – 1/16 in) long. This ant forms extremely large colonies (a million or more workers) and is becoming a dominant indoor pest because of its broad diet and habit of colony budding. Infestations may be established months before being recognized. Pharaohs are one of the few North American ants that are active all year.



Pharaoh Ant

The pharaoh ant prefers to nest at temperatures between 27 - 30°C (81 – 86°F). In the North, pharaoh ants do not nest or survive winter outdoors. Indoors, this species is commonly transferred between buildings in furniture, food packages, laundry, and other items. Indoor nests may be found by examining areas adjoining heating systems and searching for ant trails near hot-water pipes.

Although pharaoh ants forage on many foods (they are especially fond of mint-apple jelly), worker ants need protein and carbohydrates from dead insects, meats, bacon, liver, blood, and honey. A constant food source seems important for pharaoh ants. Removing the food source has sometimes caused pharaohs to leave the building. Pharaoh ants penetrate packaged food and may gnaw holes in silk and rubber. Sources of moisture draw foraging ants to kitchen and bathroom faucets, dishwashers, water coolers and water leaks.

This ant is extremely difficult to manage in structures because colonies tend to multiply (or bud) when treated with chemicals. Since most buildings provide abundant habitat, budding occurs as queens leave the colony accompanied by a number of workers who aid in the establishment of a new colony.

Budding often produces more colonies than the original one that provoked the use of pesticides.

The entire life cycle of workers is complete in 38 to 45 days at room temperature, and life span is about 60 to 70 days. There may be twelve or more pharaoh ant colonies in a building; however, only ten percent of the workers forage for food or water at any given time.

Pharaoh ants prey on bedbugs, and pose significant health threats, especially in hospitals. They may carry more than twelve different pathogenic disease organisms picked up from bedpans, toilets, drains, and washbasins. Once the ants are infected, pathogenic organisms quickly spread through the colony from direct contact as well as through food exchange.

PAVEMENT ANT *Teramorium caespitum* (L)

Pavement ants, originally from Europe and Asia, are distributed mostly in urban areas. They are common along the Atlantic seaboard, less common in the southern states and uncommon inland except in large cities such as Cincinnati and St. Louis. Pavement ants are rarely found in California. Although this ant does not compete well with native ants in rural areas, its range seems to be increasing.



Pavement Ant

The pavement ant is a small, .3 cm (1/8 in) long, blackish-brown species with two nodes on the petiole, a twelve-segmented antenna, a shiny abdomen, dull red-brown head and thorax. This is caused by minute, but easily visible parallel grooves. It has pale legs and antennae. The thorax bears two small spines on the top rear. Most complaints about small ants are caused by annoying pavement ants invading structures throughout the year, especially during summer when they get into everything from food to shoe polish.

Pavement ants nest outside under rocks, next to pavement edges, on door stoops and patios, and also establish colonies inside buildings between foundation and sill plates. This species enter through heating ducts, cracks in the slab and other open areas, and nest in wall voids and bathroom plumbing trap areas. Pavement ants may bite and sting causing an allergic reaction or rash.

Pavement ants store debris including sand, seed coats, dead insect parts, and sawdust from building construction in the nest, which the workers clean out when the nest needs to be expanded. This material is often seen in small piles on basement floors where it may be confused with carpenter ant frass. Pavement ants normally swarm in late spring, but large swarms may originate inside heated structures at any time of year.

Pavement ants are omnivorous scavengers with few food preferences, but they seek sweet and greasy materials, dead insects, and seeds. Outside, they tend honeydew-producing insects (root aphids and mealy bugs), and are often pests on eggplants, peanuts, and strawberries. Closely related, trailing species are often introduced via tropical plants into structures, where they flourish in warm, moist environments.

ODOROUS HOUSE ANT (*Tapinoma sessile* [Say])

The odorous house ant is a trailing, non-stinging, native species that occurs in all 48 continental states from sea level to over 10,000 feet in elevation. It has a single node on the petiole, is brownish to black in color, and .3 cm (1/8 in) long. Colonies are multi-queened and seldom swarm. The odorous house ant (and the Argentine ant) is probably the most common found in North American buildings. It is primarily distinguished from the Argentine ant by a darker color and an unpleasant odor when crushed.

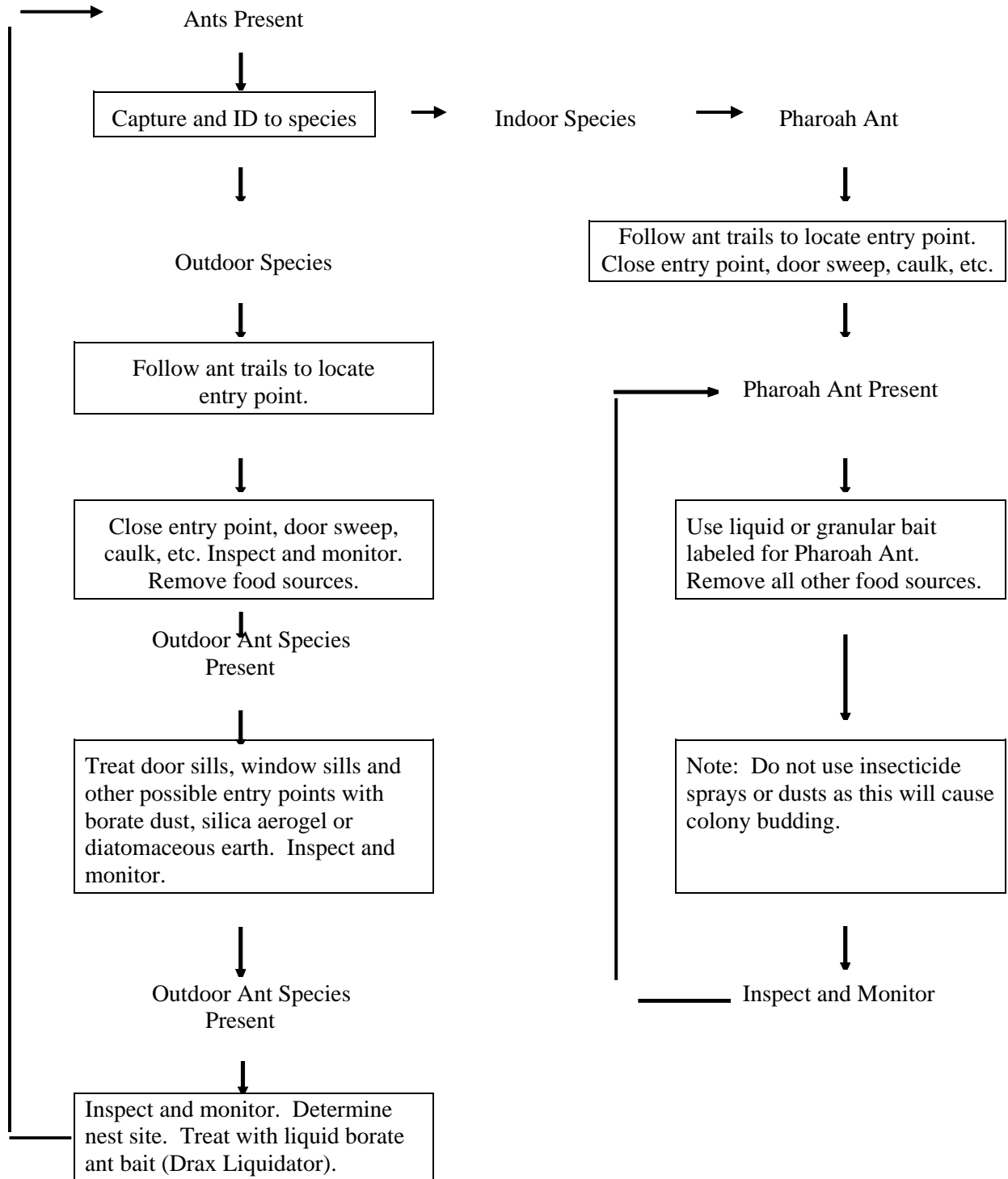


Odorous House Ant

Outside, odorous house ants tend honey-dew-producing insects. Inside, workers prefer sweets but, strangely, sweet baits are seldom effective. Although this ant may invade structures at any time of the year, it becomes an indoor pest at the start of the rainy season, when aphids and honeydew are washed down from plants by rain, and then again late in the year when leaves fall.

Odorous house ants nest outside, are usually shallow and located under boards or stone. Indoors, the nests are found in walls, woodwork, under floors (especially around heat sources), and sometimes in old termite tubes.

ANTS



BROWN ROT

Wood rots are a group of microscopic organisms (fungi) that discolor and decay wood. These fungi are unable to produce their own food so they feed upon natural organic substances such as wood and paper, etc. Fungi fruiting bodies release many spores that are moved by wind and rain. When the spores land on wood in the presence of water, they germinate, sending out thread-like hyphae. Enzymes secreted by the hyphae break down organic matter in wood so the fungi can use it for food. For fungi to use wood for food, it must have oxygen, 4 – 38°C (40 – 100°F) temperature range, a supply of moisture and a food source – wood.

Brown rot fungi feed on the wood's cellulose, a component of the cell wall. The fungi leave behind the brown lignin, which holds the wood cells together. Infested wood may be greatly weakened and becomes a darker brown than normal. Brown rot causes wood to crack across the grain and shows cubical checking. When brown rot damaged wood is dried, it will turn to powder when crushed. Brown rot that has dried is sometimes called dry rot.



Brown Rot Fungi

Treating wood with borates (BoraCare or TimBor Pro) will prevent brown rot and stop brown rot from further damaging the wood.

WHITE ROT

Wood rots are a group of microscopic fungi that attack and decay wood. These fungi cannot produce their own food so they feed on natural organic substances such as wood and paper, etc. Fungi fruiting bodies release spores that are carried by wind or rain until it reaches a susceptible substrate. When the spores land on wood where there is oxygen and 4 – 38°C (40 – 100°F) temperature, they germinate and send out hyphae to break down wood for its nutrients.



White Rot Fungi

When white rot attacks wood, it breaks down both lignin and cellulose causing the wood to lose its color and appear whiter than normal. Wood infested with white rot will shrink and collapse, eventually losing its strength and becoming spongy. Wood with white rot usually does not crack across the grain.

Wood treated with borates (BoraCare, TimBor Pro) will prevent white rot from infesting wood and/or stop further damage to the wood from white rot.

WATER-CONDUCTING FUNGUS, *Poria incrassata*

Poria can attack wood without the initial presence of water. This wood rot fungus can transport water for several feet through large root-like structures called rhizomorphs. When established, it can quickly spread through a building and destroy large portions of the structural wood.

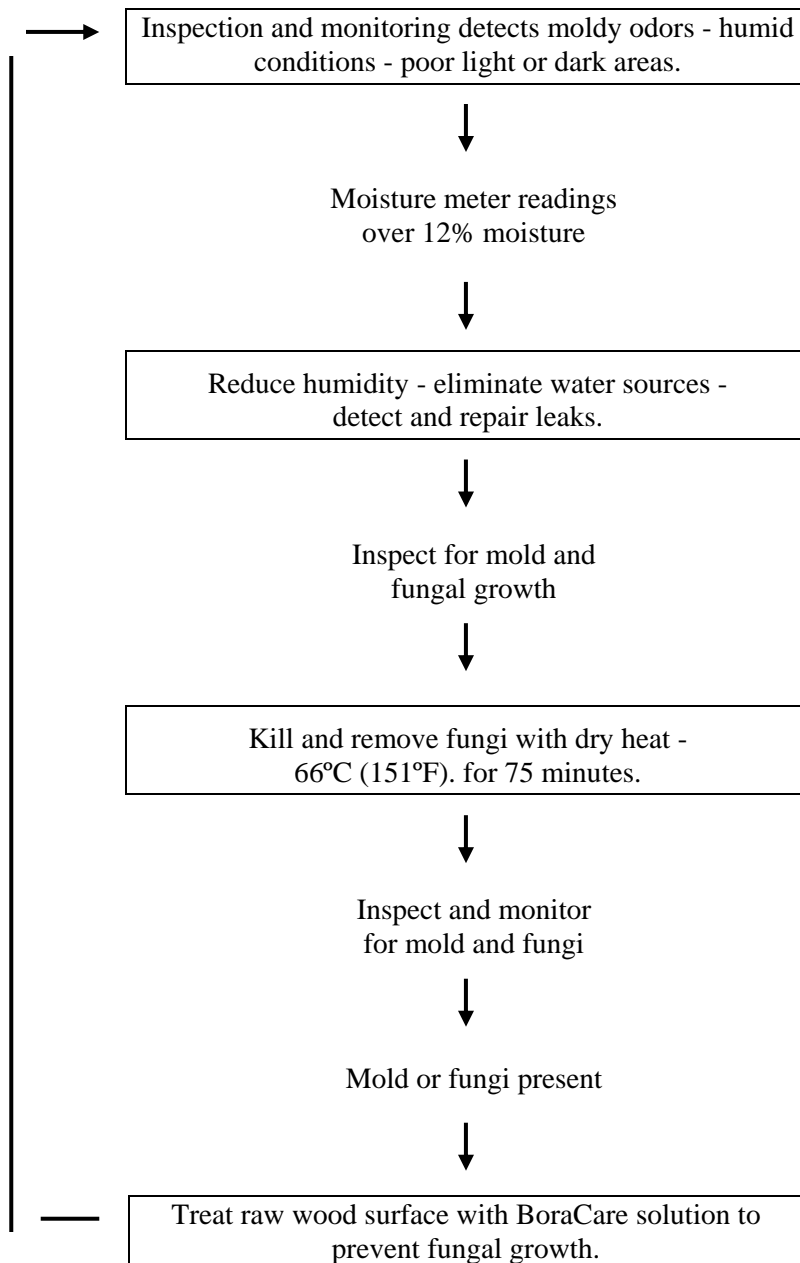


Poria incrassata

Typically, *Poria* infestations start in dirt-filled porches, damp crawlspaces and basements or where wood is in contact with soil. It can also begin in moist concrete or damp bricks. At first, yellowish mycelial fans grow over the surface of wood and other moist areas. The rhizomorphs are small hair-like hyphae that can grow to 2.54 cm (1 in) or more in diameter in older infestations. When *Poria* infested wood dries, it usually shrinks and cracks across the grain.

Wood treated with borates (BoraCare, TimBor Pro) will prevent *Poria* from infesting wood and/or stop further damage to the wood from *Poria*.

MOLDS AND FUNGI



HOUSE MOUSE

INTRODUCTION

The house mouse (*Mus musculus*) easily adapts to living with people. It thrives in a wide range



of climatic conditions in a great variety of habitats, feeding on most human food, and reproducing at a remarkable rate. House mice subsist throughout the United States, and are found in most areas of human habitation. They are also found living in the wild. They are common inhabitants of grassy fields, and a problem in residences and structures. Not only does the house mouse destroy food and cause damage to structures and personal possessions, it also has the potential to transmit diseases and parasites to people and domestic animals.

House Mouse *Mus musculus*

CHARACTERISTICS AND RECOGNITION

The house mouse is a delicate, agile little rodent. Adult weights vary by region and usually range from 14 – 28 gr (1/2 – 1 oz). Adult house mice vary in color from light brown to dark gray, but most often are a dusky gray or medium brown over most of their bodies, except the belly, which may be a slightly lighter shade of their general color but never white. The mouse has moderately large ears for its body size. The tail is nearly hairless and about as long as the body and head combined (6.35 – 10.16 cm (2 1/2 – 4 in). The feet are small in proportion to its body, and the eyes are also relatively small.

Under optimum conditions, house mice breed year round. Out-of-doors, house mice may tend toward seasonal breeding, peaking in the spring and fall. Environmental conditions, such as the availability and quality of food, can influence the frequency of pregnancy, litter size, and survival. Females may produce as many as ten litters of five young in each litter in a year. At very high densities, however, reproduction may nearly cease despite the presence of excess food and cover.

Newborn mice are quite undeveloped, weighing between .57 – .85 gr (.02 – .03 oz) and are nearly hairless. Their eyes and ears are closed, but within two weeks the body is covered with hair and the eyes and ears are open. At about three weeks, the young begin short trips away from the nest and begin taking solid food.

While mice primarily are active at night, some day activity occurs. Movements of house mice are largely determined by temperature, food, and hiding places. Home ranges of mice tend to be smallest where living conditions are good. Mice tend to travel over their entire territory daily, investigating each change or new object that may be placed there. They are very aggressive. They show no fear of new objects. They dart from place to place, covering the same route over

and over again. This behavior can be used to advantage in management programs. Disturbing the environment at the beginning of a program by moving boxes, shelves, pallets, and other objects can improve the effectiveness of traps. Mice will investigate the changed territory thoroughly.

Mice have relatively poor vision, and are also color blind. They rely heavily on smell, taste, touch, and hearing. Mice use their keen sense of smell to locate food and to recognize other individuals, especially those of the opposite sex. Taste perception in mice is also good. Mice use their acute hearing to detect and escape danger. An important sensory factor for mice is touch. Mice use long, sensitive whiskers near the nose and guard hairs on the body as tactile sensors to enable them to travel in the dark, pressing against walls and boxes, scurrying through burrows.

It is a challenge to mouse-proof a building or manage mice without understanding their physical capabilities. For their size they are excellent jumpers. They can jump against a wall or flat vertical surface, using it as a spring board to gain additional height. They can run up almost any vertical surface including wood, brick walls, metal girders, pipes, weathered sheet metal, wire mesh, and cables without difficulty if the surface is rough. They can run horizontally along insulated electrical wires, small ropes, and the like, with ease. They can squeeze through openings slightly more than .64 cm (1/4 in). They are quick to explore any physical change in their environment.

House mice prefer cereals over other items, although they feed on a wide variety of foods. Mice satisfy much of their water need with moisture in their food, but they drink if water is readily available. Mice have two main feeding periods, at dusk and just before dawn, and they are nibblers, feeding twenty or more times during evening rounds. In any territory there will be one or two feeding sites, dark and protected, where mice eat more than at other places.

Mice are territorial and seldom travel more than thirty feet from their nest. When food is nearby, mice may restrict their activity to a few feet. Males average slightly larger ranges than do the females. House mice may nest in any dark, sheltered location, in nests approximately 10.16 cm (4 in) in diameter and constructed of fibrous, shredded materials such as paper, cloth, burlap, insulation, or cotton, which generally look like a loosely woven ball. Outdoors, house mice sometimes dig and nest in small burrows.

HAZARDS OF INFESTATION

When mice infest stored food, the greatest loss is not what mice eat, but what is thrown out because of real or suspected contamination. Mice also damage personal property and structures by gnawing, including electrical wiring in buildings. House mice frequently take up residence in electrical appliances and end up chewing into the power supply.

House mice and their parasites are implicated in the transmission of a number of diseases. Salmonellosis can be spread when some foods are contaminated with infected rodent feces. Mice are probably more responsible than rats for the spread of this disease. *Rickettsia akari* is the causal agent of Rickettsialpox, a disease causing a rash similar to chickenpox. Rickettsialpox

is transmitted from mouse to mouse, then to people by the bite of the house-mouse mite. Lymphocytic Choriomeningitis is a virus infection of house mice that may be transmitted to people (mainly to children) through contaminated food or dust. The mouse can also be a major carrier of Leptospirosis (Weil's disease). Rat-bite fever can be transmitted by house mice, as can ray fungus, *Actinomyces muris*. Certain tapeworms are spread in house-mouse droppings, and ringworm, a skin fungus disease, can be carried to human beings by mice or contracted indirectly from mice through cats. Tularemia has also been linked to house mice.

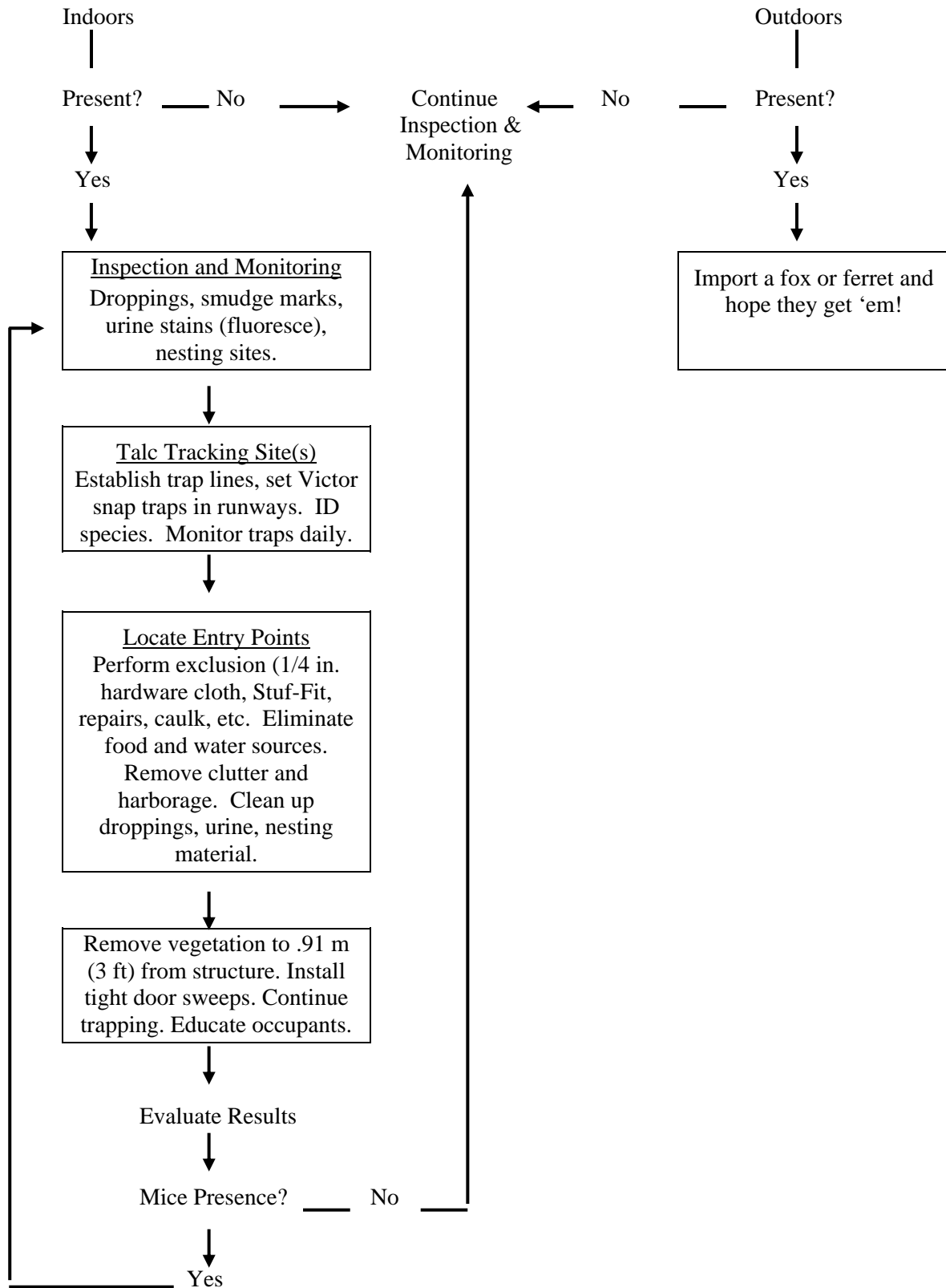
INSPECTION AND MONITORING

Sounds are common at night where large numbers of mice are present. Listen for squeaks, scrambling, and sounds of gnawing. An electronic stethoscope is useful.

Mouse droppings are frequently the first evidence that mice are infesting. Large cockroaches, bats, and other species of mice such as deer mice (*Peromyscus* sp.) and meadow mice (*Microtus* sp.), may produce droppings similar to those of house mice. Look along runways, by food, near shelters, and in other places mice may frequent. House mice occasionally make small mounds known as "urinating pillars." These consist of a combination of grease, urine, and dirt, and may become quite conspicuous. Look for many small drops of urine using a black light, since urine stains will fluoresce under ultraviolet light.

Like rats, mice produce greasy smears where dirt and oil from their fur mark pipes and beams. Recent gnawing damage on wood is light in color and will turn darker with age. Look for enlarged cracks beneath doors and small tooth marks. Such evidence frequently helps to distinguish between mice and rats. Look for wood chips with the consistency of coarse sawdust around baseboards, doors, basement windows and frames, and kitchen cabinets.

HOUSE MICE



DEER MOUSE / WHITE FOOTED MOUSE

The native deer mouse (*Peromyscus maniculatus* [Wagner]) is the rodent in the United States that most commonly carries the Hantavirus, and is implicated in most of the cases of human infection by this strain. The white-footed mouse (*Peromyscus leucopus* [Raphinesque]) also carries Hantavirus. The deer and white-footed mice are also the most likely native rodents to be found in or near buildings. The deer and white-footed mice often invade homes and structures that are closed for the season. If outside populations are large, structures may have numerous *Peromyscus* sp. present, which may result in substantial amounts of saliva, urine and droppings with the Hantavirus aerosolized into the interior air and in dust. The opportunity for human exposure is great when the structure is reopened for use. See Introduction to Mice for Hantavirus remediation.

CHARACTERISTICS AND RECOGNITION



Deer Mouse *Peromyscus maniculatus*

Appearance

The deer mouse is the most widely distributed and the most variable member of the genus. Color ranges from pale grayish buff to deep reddish brown. The tail is always sharply bicolored, dark above and white below. Head and body are 7.11 – 10.16 cm (2 4/5 – 4 in) long and the tail is 5.08 – 12.7 cm (2 – 5 in). The deer mouse weighs only 19 – 35 gr (2/3 – 1 1/4 oz). The eyes and ears are moderate size and prominent and the tail is covered with short fur.

Habitat and Habits

The deer mouse is versatile and occupies nearly every dry land habitat within its range from forests to grassland and a mixture. With the exceptions of Virginia, North and South Carolina, Georgia, Florida, Alabama, Mississippi and Louisiana, the deer mouse can be found throughout the continental United States (including part of Alaska) and Canada. In the east, deer mice are found from the Hudson Bay south to Pennsylvania and the southern Appalachians. They build a large globular nest in burrows in the ground, in trees and stumps, and buildings. The deer mouse feeds on seeds, nuts, acorns, berries, small fruits, and adult and larval insects, and can carry food in a cheek pouch to be stored in its nest. The home range is one-half to three acres or more. A summer population of 10 to 15 per acre is high, although they may congregate in winter. They rarely live more than two years in the wild. Females may show territorial behavior in the breeding season, which may vary with latitude, normally February to November. There may be two to four litters per year with one to eight naked and blind young (usually three to five) per litter. Gestation period is 21 – 27 days. Deer mice are nocturnal, feeding mostly at dusk and dawn. They are excellent climbers and fast runners.

Appearance

The white-footed mouse is found in the east from Maine south to Georgia. Identifying the various species of *Peromyscus* may require a rodent taxonomist. The white-footed mouse is bicolored with the upper parts grayish to rich reddish-brown, with the belly and feet white. The tail is also bicolored. The head and body length are about 1.4 – 10.5 cm (3 9/16 – 4 1/8 in), tail length is 6.2 – 10.2 cm (2 7/16 – 4 in). Ears are small, 1.3 cm (1/2 in) and weight is about 10.6 – 42.5 g (3/8 – 1 1/2 oz).



White-footed Mouse
Peromyscus leucopus

Habitat and Habits

White-footed mice are nocturnal. They build nests in concealed locations such as old bird or squirrel nests, burrows, stumps, logs or buildings. They feed on seeds, nuts, fruits, beetles, caterpillars and other insects. Caches of seeds and nuts are stored near the nest. Home range is 1/2 – 1 1/2 acres. They are active year around. Females have two to six young per litter, and two to four litters per year. The gestation period is 21 – 24 days and females can begin breeding at 10 – 11 weeks old. The lifespan is two to three years in the wild.

INSPECTION AND MONITORING

Droppings

Observing droppings indoors where native mice have tunneled, fed and nested are telltale signs of their presence. Outdoors runways in grassy areas may be observed, and droppings may also be present. Fresh mouse droppings are dark and shiny, then turn dull and gray as they age. Large numbers of droppings in a small area indicate a feeding or resting site. Droppings and urine will also be found in the nest.

Runways

Outdoors runways may be distinct as grass is clipped and the trail may show. Inside the runways that are being used will show as dust free areas, usually next to walls or other objects.

Tracks

Outdoors in soft soil or dirt areas look for tracks and tail marks in the dust. Deer and white-footed mice (and others) have large hind feet with five toes and small front feet with four toes. Indoors a non-toxic tracking patch (talc) 15.24 x 25.4 cm (6 x 10 in) and .15 cm (1/16 in) deep can be placed on the floor to determine activity. Place several patches in the area near possible food sources, or other critical areas.

Visual Sightings

If possible, make observations at night as most *Peromyscus* are nocturnal. Use a powerful flashlight or spotlight to check storage spaces or other food or harborage sources. Disturbed mice will rapidly run to shelter.

PEST MANAGEMENT MEASURES

Management of native mice consists of preventive measures such as exclusion, sanitation, habitat modification, and population reduction with snap traps.

Exclusion

If you keep them out, they can't get in! Exclusion may be the most important aspect of native mouse management. All holes, cracks, crevices or other openings larger than .3 cm (1/8 in) must be filled, covered or otherwise blocked to keep mice out.

As the native rodents can gnaw through wood or other soft substances, burrow into soil, and are good climbers, keeping the structure in good repair is important. Use hard material such as metal flashing, concrete and 1/8 in. hardware cloth for exclusion. Doors and windows should also close tightly.

Sanitation

Keep food and water in clean, tightly closed containers that are resistant to rodent attack. Removal of clutter and debris will also deter rodent activity. If rodents are suspected or observed inside the structure, very strict procedures need to be followed.

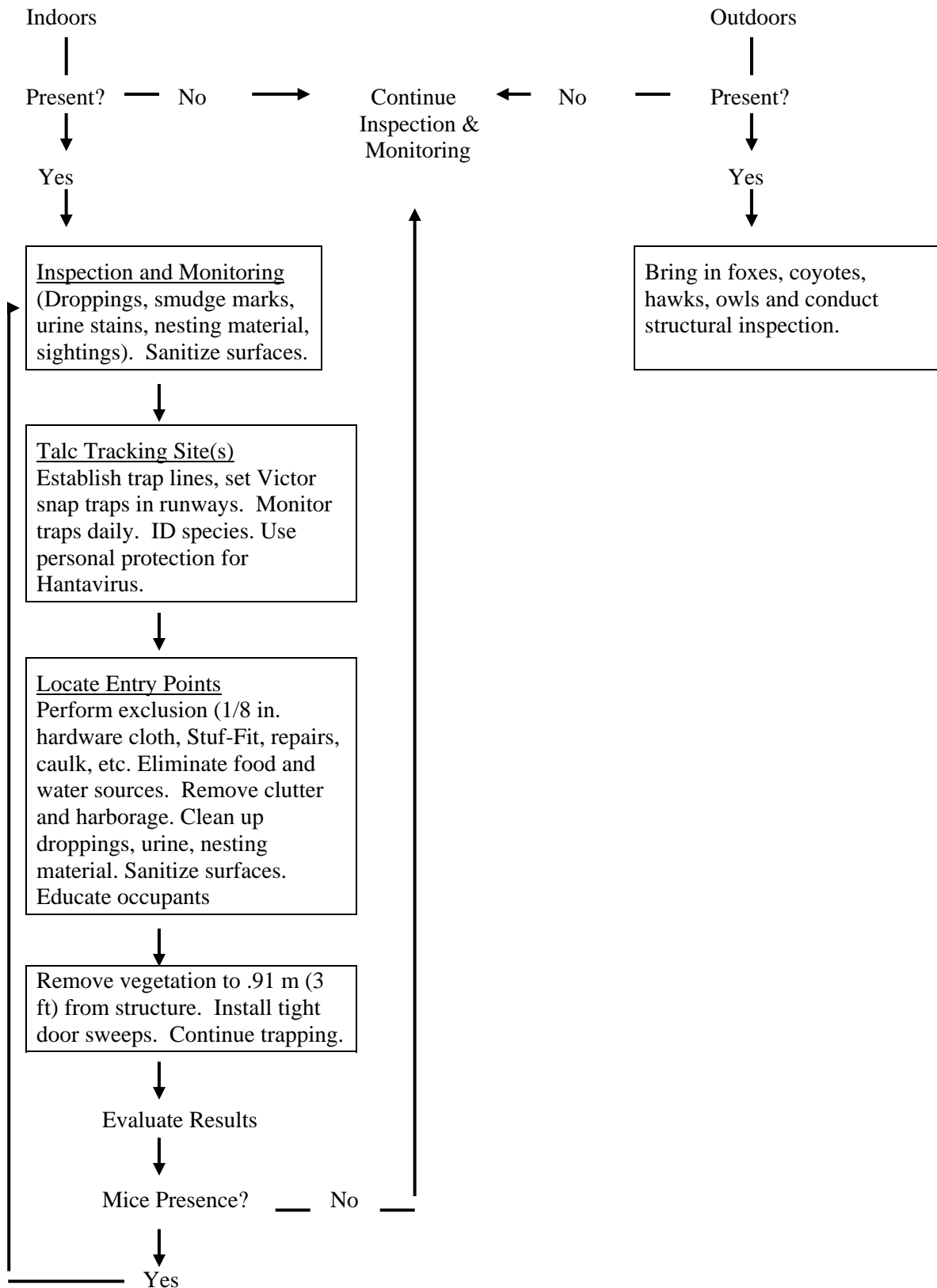
Habitat Modification

Another preventive or remedial measure that can be taken outdoors to reduce the opportunity for rodent/human exposure is to remove brush, weeds and other materials from around structures to reduce protected hiding places for rodents. Modifying protective cover makes native rodents more susceptible to predation by hawks, owls and other natural predators. A gravel barrier 10.16 – 15.24 cm (4 – 6 in) deep and .91 m (3 ft) wide next to the structure reduces rodent intrusion.

Trapping

Because of the risk of exposure to the Hantavirus, if native rodents are dwelling inside structures, lethal force in the form of snap traps is recommended. Do not use live traps. Do not use rodenticides or other toxic means for rodents inside structures. Baits that may be used in the snap traps are seeds such as conifer seed, chunky peanut butter, sunflower seed, oats, or cotton balls (plain or with vanilla flavor). Traps should be placed in observed runways or near resting and feeding sites. Check traps daily. Wear rubber or plastic gloves when handling killed mice. Remove dead mice and treat with a disinfectant to kill Hantavirus.

DEER / WHITE-FOOTED MICE



EASTERN GREY SQUIRREL *Sciurus carolinensis*



Grey Squirrel

Eastern grey squirrels commonly occur in two color phases, grey and black, which leads people to think that there are two different species. Its most notable physical feature is its large bushy tail, which has important functions. It acts as a rudder when the animal jumps from high places, as a warm covering during the winter, as a signal to other eastern grey squirrels indicating an individual's mood, and perhaps as a sunshade. The tail can also be used to distract a pursuing predator.

The tracks of eastern grey squirrels are distinctive; forefeet leave a round print about 2.5 cm (1 in) long; the hindprints are more triangular, approximately 6 cm (2 in) long.

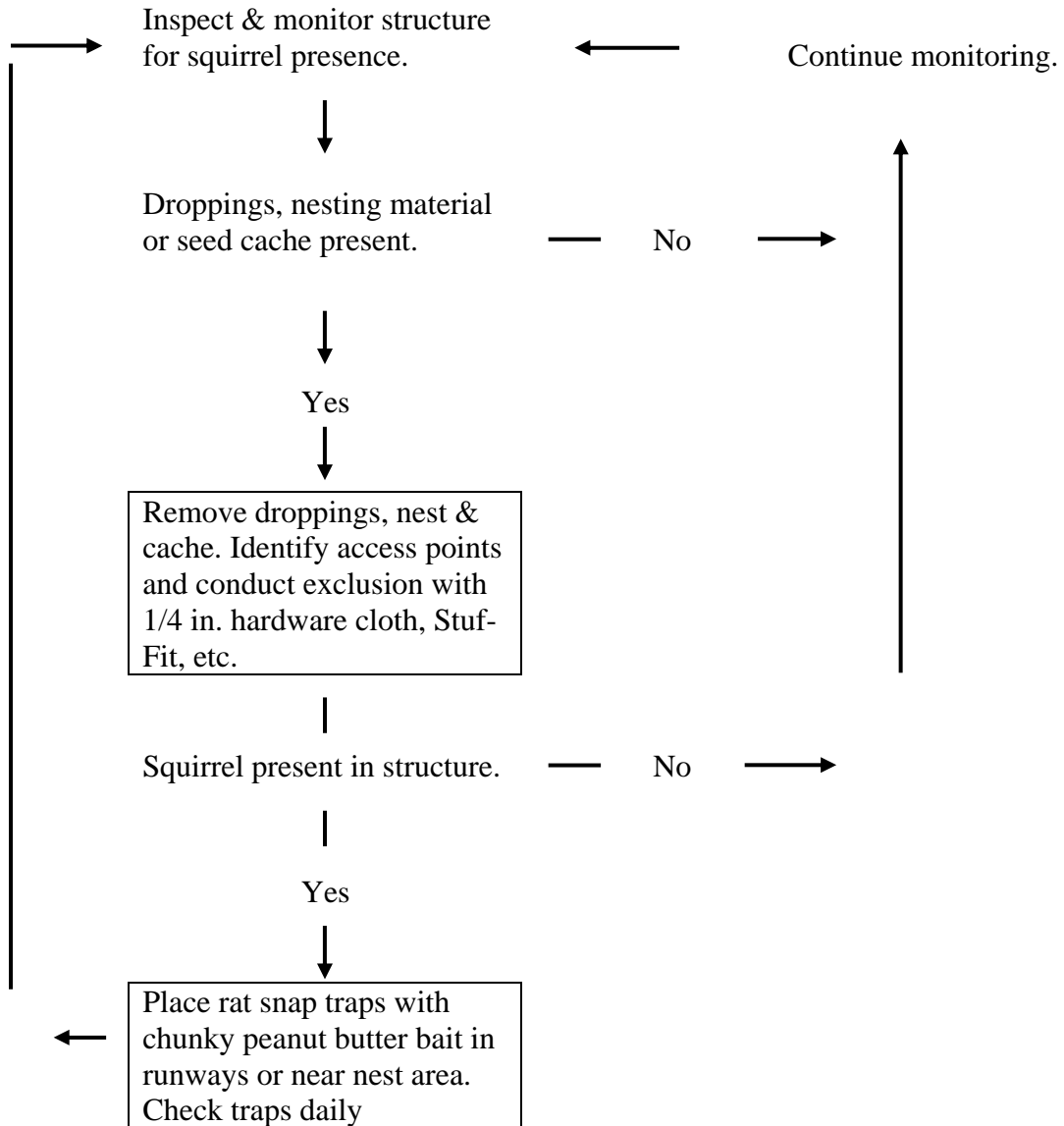
The eastern grey squirrel has two breeding seasons each year, the first in January and February and the second in June and July. Each of the mating periods lasts for about three weeks. Generally, only females over two years of age will breed in both seasons. Gestation takes 40 – 44 days. An average of three young are born, although the litter size may range from one to six.

Squirrels build nests near the tops of large pine, hemlock, maple, birch and oak trees where they are lodged in a large crotch or on a limb near the trunk. Mosses, grasses and shredded bark line the nest, occasionally along with cloth, paper, vegetation and bird feathers.

The newborn young weigh about 15 g (1/2 oz), mature quickly and at about 12 weeks, the young will be almost adult size and independent. The males reach sexual maturity at 15-18 months and the females at 11 months. The average lifespan is normally less than six years.

Grey squirrels can become a nuisance when they invade an attic, cause damage around the house, dig up bulbs in gardens or drive birds away from feeders. Prevent squirrels from climbing trees or poles by encircling them with a .61 m (2 ft) wide collar of metal 1.82 m (6 ft) off the ground. Overlap the metal collar to allow for tree growth. Trim trees back from structures to prevent squirrels from jumping onto them. Prevent squirrels from traveling on wires by installing a 1.82 m (2 ft) section of lightweight 6 – 7.62 cm (2 – 3 in) plastic pipe (slit pipe lengthwise to spread it open and place it over the wire). Close all openings into the structure with sheet metal or 1/4 in. hardware cloth to prevent squirrel access. If squirrels have gained access to the interior of a structure, rat traps baited with chunky style peanut butter are effective. Check traps daily to remove captured squirrels and reset traps.

GREY SQUIRREL



BIG BROWN BAT

Big brown bat, *Eptesicus fuscus* (Beauvois) is not a pest, and is actually beneficial to the Park, except for roosting in the attics. Adult big brown bats are about 10.16 – 12.70 cm (4 – 5 in) long including the tail, with a wingspread of 30.5 – 36 cm (12 – 14 in), and they weigh 11 – 17 gr (2/5 – 3/5 oz). They are found throughout southern Canada and the United States (except southern Florida). These bats usually give birth to two young during April to July. The big brown bat females form nursery colonies in structures in the spring (the males roost elsewhere). Later in the summer, the two sexes roost together. They commonly roost in attics, behind shutters and loose boards in buildings. They usually feed near the ground on beetles, wasps, ants, planthoppers, leafhoppers, flies, moths, etc. The big brown bat commonly hibernates in structures, caves, mines or rock crevices from December to April.



Big Brown Bat (*Eptesicus fuscus*)

Winter exclusion efforts are not suggested if big brown bats are hibernating in the Park attics. Summer exclusion can be accomplished when the young are flying after mid-August. Seal all exit/entry points except one or two, and all holes .64 cm (1/4 in) or larger. After a few days to a week when bats are used to only the two exit points, install bat check valves (which allow bats to exit but not return) or seal exits after bats have left for foraging. Providing a proper bat house before the exclusion will allow the bats to remain in the area to feed on flying insects.

LITTLE BROWN BAT

Little brown bat, *Myotis lucifugus* (LeConte), is actually a benefit to the Park except for roosting in attics. Adults are about 7.92 – 9.19 cm (3 1/8 – 3 5/8 in) long, including the tail, with a wingspread of 22 – 27 cm (8 11/16 – 10 5/8 in). They weigh .34 – 14 gr (1/8 – 1/2 oz). Little brown bats are found from middle Alaska through southern Canada, and in the United States except Florida, Texas and southern California.

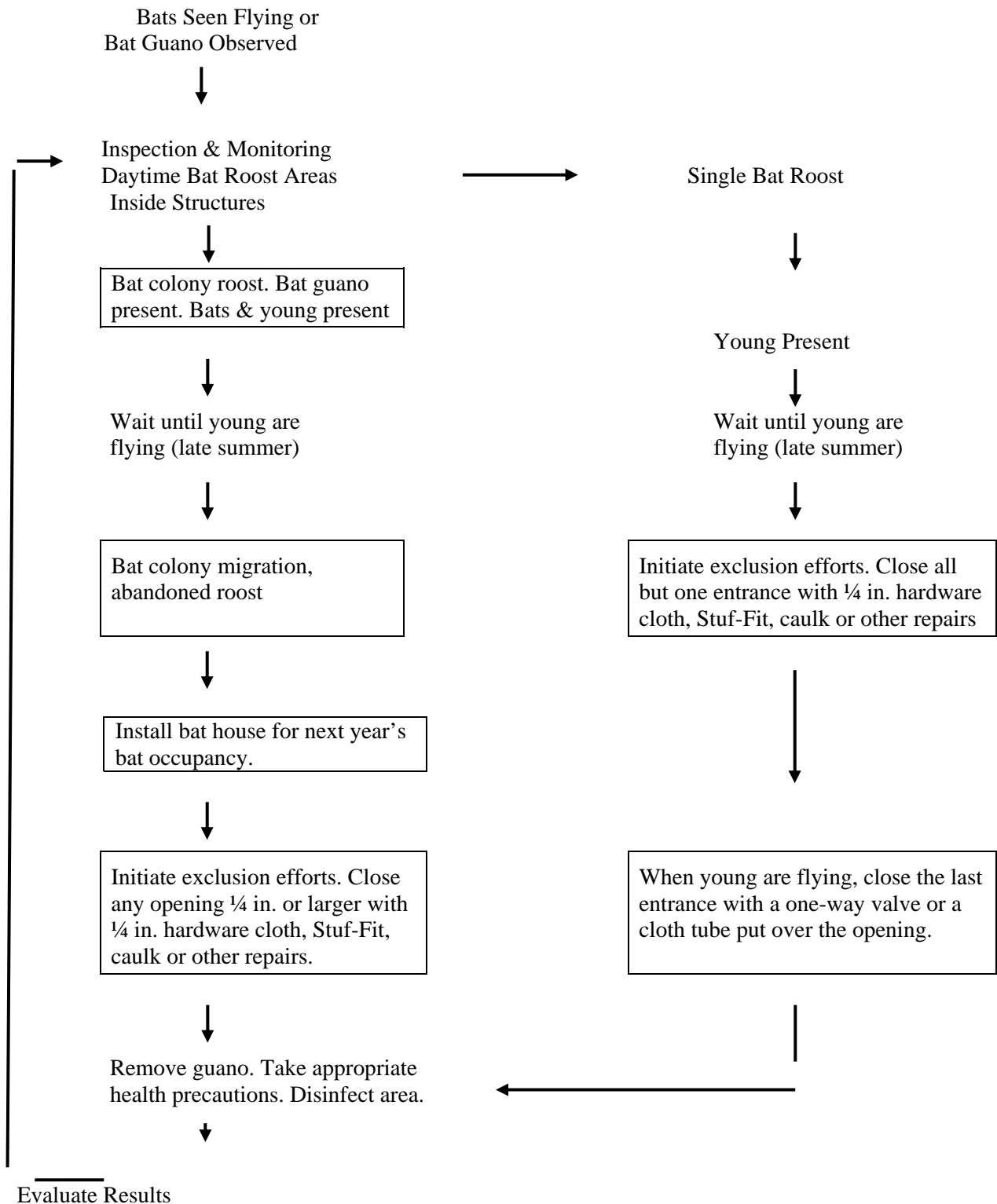


Little Brown Bat (*Myotis lucifugus*)

Little brown bats form nursery colonies in the spring. They feed on flying insects, especially flies and moths. They alternate feeding flights with rest periods to digest the catch. In the north, most little brown bats will migrate south where they hibernate from September/October through March/April in mines and caves in the eastern U.S.

If bats have left the attics of the Park structures in winter (and there are no big brown bats hibernating there), thorough exclusion of the attics at the Park can be accomplished. Otherwise, after mid-August when young are flying, close all exit/entry holes (over .64 cm [1/4 in]) except two exits. When bats have adjusted to those two exits, install bat valves or seal the last two holes after all bats have left for evening foraging. Providing a proper bat house before the exclusion will allow the bats to remain in the area to feed on flying insects.

BATS



BIRDS

INTRODUCTION

Birds provide enjoyment and recreation, enhancing the quality of life for those who view, enjoy, study, photograph, or hunt them. However, birds can become pests when they create health hazards, roost on buildings, contaminate food, or create a nuisance. Pigeons, starlings, sparrows and other birds, for example, cause human health problems when roosting in large numbers, and their droppings can foul buildings and walkways. Whether birds are seen as beneficial or harmful depends on time, location, and activity. Barn swallows, robins and phoebes have historically been the pest bird species at SAGA.

CHARACTERISTICS AND RECOGNITION

Barn Swallows (*Hirundo rustica*)



Barn Swallows

Barn swallows are 15.24 – 17.75 cm (6 – 7 in) long, a dark steel-blue/black head and back, long thin wings, and a deeply forked tail. The forehead, throat and breast are a rich chestnut color, and the underside is a light brown.

Habitat and Habits

Barn swallows migrate to Central and South America to winter. They almost always nest in buildings or structures throughout most of North America. Nests are built of mud pellets reinforced with grass or straw and lined with fine grass and feathers. Nests are attached to rafters or walls under eaves, near the ceiling of barns, outbuildings, bridges or beneath piers. These migrating birds often return in the spring to the same prior nesting places.

Barn swallows feed exclusively on insects caught while flying, especially during nesting season. In late summer, they feed on berries when they gather into flocks before migrating. The female lays three to six speckled white eggs which hatch after about two weeks' incubation. Fledglings can leave the nest in about three more weeks. The parent barn swallows will raise two broods each year. Fledglings from the first brood remain and help feed the next brood.

Management

Install metal or plastic 45° angles to the underside of eaves or on ledges to prevent bird nest building. Barn swallows are beneficial as they capture and eat flying insects.

American Robin (*Turdus migratorius*)

Robins are 25.4 cm (10 in) long and 20.32 cm (8 in) tall. They have a black head with a small white spot above the eye, and a yellow bill. The back and wings are slate gray with a black tail and a chestnut underside.

Habitat and Habits

The robin inhabits most of North America from Mexico to the Hudson Bay region, Alaska and beyond the tree lines into the Arctic. They inhabit forests, orchards, tree stands in open country, farms and cities. They build their nests on ledges on houses and in trees at 1.52 – 7.62 m (5 – 25 ft) high. The large nest is made of twigs, roots, grass and leaves and is lined with a clay cup. This clay cup is lined with fine grass, hair or wool.



American Robins

The female lays three to five blue/green eggs which hatch after two weeks' incubation. The young fledglings leave the nest in about two weeks. The adults raise two to three clutches in a season. Robins forage in open meadows and lawns for earthworms, grubs and some insects. They may also feed on berries and a variety of other fruit.

Robins will migrate south in the winter, but tend to return to the same area and nesting site each year.

Management

Install 45° angle metal or plastic barriers on ledges to prevent nest-building on a structure. Remove nests and clean the area during winter migration. Use a low-risk insecticide on the abandoned nest if mites or other parasites are present. Robins are beneficial in feeding on insects in turf and meadows.

Eastern Phoebe (*Sayornis phoebe*)



Eastern Phoebe

The eastern phoebe is 15.24 – 17.75 cm (6 – 7 in) long, has a brown head with a slight crest, a gray/brown back, gray wings with white bars and a white underside. The feet and bill are black.

Habitat and Habits

This phoebe inhabits woodland edges, shady ravines, river bottoms and open fields. They are found through most of southern Canada, down into the eastern United States to the Great Plains and into Georgia. They migrate to the Caribbean and Mexico for winter. They build nests of twigs, roots and moss, cemented with mud and lined with grass, hair and feathers. They often nest on house ledges

under eaves, in outbuildings, under bridges, in culverts, caves and wells, usually in the same place year after year. Phoebe is the most familiar flycatcher in eastern North America.

Phoebes mate for life and often rear two broods in a season. The female lays four to six speckled white eggs which hatch after two weeks' incubation. The young fledglings leave the nest in about another two weeks. Phoebes feed on flies, moths, bees and other insects they catch "on the fly." They also eat berries.

Management

Install metal or plastic 45° angle barriers on all ledges. Remove old, abandoned nests during winter. Treat nests with a low-risk insecticide if mites or other parasites are present to prevent their entry into the structure.

HAZARDS OF INFESTATION

Large populations of roosting birds may present risks of disease to people nearby. The most serious health risks are from disease organisms growing in accumulations of bird droppings, feathers, and debris under a roost. If conditions are right, particularly if roosts have been active for years, disease organisms can grow in these rich nutrients. Birds may contaminate food. When parasite-infested birds leave roosts or nests, their parasites may invade buildings and can bite, irritate, or infest people.

Histoplasmosis

This systemic fungal disease (mold) is transmitted to humans by airborne spores from soil contaminated by droppings (as well as from the droppings of other birds and bats). The soil under a roost usually has to have been enriched by droppings for three years or more for the disease organism (*Histoplasma capsulatum*) to increase to significant levels. Although almost always associated with soil, the fungus, in rare instances, has been found in droppings alone, such as in an attic. Infection is by inhalation of the spores carried by wind, particularly after a roost has been disturbed.

Most infections are mild and produce either no symptoms or a minor flu-like illness. The disease can, on occasion, lead to high fever, blood abnormalities, pneumonia, and even death.

The National Eye Institute (NEI) at National Institutes of Health has reported a potentially blinding eye condition, called ocular histoplasmosis syndrome (OHS). OHS results from infection by *Histoplasma capsulatum*. In this condition, the central part of the retina (the macula, used in straight-ahead vision) becomes inflamed and is damaged as blood vessels grow inside the affected area.

Cryptococcosis

Droppings appear to be the most important source of the disease fungus, *Cryptococcus neoformans*, in the environment. The fungus is typically found in accumulations of droppings in attics, on ledges, and on other roosting and nesting sites on buildings.

The disease is acquired by inhaling the yeast-like vegetative cells (two to three microns) of the organism. There are two forms of Cryptococcosis that may infect humans. Acne-like skin eruptions or ulcers characterize the cutaneous form with nodules just under the skin. The generalized form begins with a lung infection, and spreads to other areas of the body, particularly the central nervous system. It can be fatal. Like Histoplasmosis, outbreaks of this disease often occur after building renovation, roost clean-up, or other actions that disturb the old droppings.

Other diseases carried or transmitted by birds affect people to a lesser degree. Psittacosis, Ornithosis and Toxoplasmosis are normally mild in human beings, although serious illness or death can occur in rare cases.

Ectoparasites

Birds harbor ectoparasites that can invade buildings. Some of these parasites can bite and irritate occupants. A long list of mites infest birds, but the northern fowl mite and chicken mite are usually the main culprits. These pests generally invade buildings from nesting and roosting sites. Other bird ectoparasites may cause problems inside buildings.

Droppings, feathers, food, and dead birds under a roosting or loafing area can also breed flies, dermestid beetles and other insects that may become major problems in the immediate area. These pests may fly or walk into windows, ventilators, cracks and crevices, and find other means to enter buildings. Structures that house museum specimens and historic artifacts can be invaded by dermestid beetle larvae that leave nesting and roosting sites.

Defacement and Damage to Structures and Equipment

Bird droppings under window sills, "whitewashing" down a building face, or accumulating on sidewalks and steps are the most obvious problems associated with roosts. Clean-up can be labor-intensive and expensive. Bird droppings are corrosive and will damage automobile finishes, metal trim, electrical equipment, and machinery. Down spouts and vents on buildings also become blocked by droppings, nest materials, and feathers. This accumulation of debris can attract insect pests such as dermestid beetles, spider beetles, and mealworms.

Legal Considerations

With very few exceptions, all birds are protected by one or more federal laws and regulations. Although barn swallows, robins and phoebes are not considered pest birds and may be protected at the federal level, repellents should be applied according to the product label and under the restrictions that apply under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).

Non-target birds in the treatment area are protected, and any actions that kill or damage protected birds or their habitats would be a violation of various federal and state regulations. State and local regulations may require permits or restrict the actions taken against pest birds.

When in doubt, contact your State Natural Resources Agency or the United States Fish and Wildlife Service District office in your area for further information.

INSPECTION AND MONITORING

The first step in managing birds is to conduct a detailed and accurate bird survey. Surveys should be conducted early in the morning, midday, and again in the evening to correspond to the different activity periods of birds. The survey should not be limited to information about pest birds; non-target bird activity is just as important in order to minimize risk to these birds. The surveyor should investigate:

- What birds are present?
- How many birds are present?
- Are they residents, migrants, adults, juveniles?
- Are they nesting, feeding, roosting, loafing?
- Where do they eat and drink?
- What is attracting them to the various sites?
- Are the birds causing a health risk?
- Are the birds causing physical damage?
- If dispersed, where would they go?
- Is risk involved to non-targets?
- What are the legal considerations?
- Could there be public relations problems?
- Is exclusion or habitat modification practical?

MANAGEMENT

Habitat Modification

Habitat modification for birds means limiting a bird's food, water, or shelter. Attempting to limit the food or water of barn swallows, robins and phoebes may be difficult. Elimination of food and water to local bird populations must be accomplished at sensitive sites. These birds will have a number of feeding and watering sites, often far from roosting and loafing sites. Where people are feeding birds in parks or lunch areas, education can help reduce this source of food. In some cases, people may pay little attention to requests to stop.

The most successful kind of habitat modification is to exclude the birds from their roosting and loafing sites (addressed in the section on exclusion).

High-pressure streams of water spray are the most cost effective method of nest destruction. It destroys the nest, eliminates ectoparasites, cleans droppings and feathers from the nest site, and harasses the roosting birds. Use high-pressure sprays only where the water will not damage buildings or equipment. Remove all droppings and nest materials from the area.

When spraying is not safe, use a hook fastened to a long pole to remove nests. When the nests are within 6.1 m (20 ft) of occupied sites, treat the immediate nest area with an insecticide/acaricide to eliminate ectoparasites.

Destroy nests every two weeks during the spring and summer months until the birds move to other nest sites. Nest destruction by any means is not allowed while young are in the nest.

Exclusion

Some building designs and conditions lend themselves to bird infestation. Flat ledges, openings in water towers and vents, unscreened windows, and other attributes make a building an attractive location for roosting, nesting, and loafing. Modification or repair can exclude birds. Typical solutions include replacing broken windows, adding screens, repairing damaged eaves or ventilation screens, eliminating large crevices, and blocking openings into vents, cooling towers, and roof-top equipment with hardware cloth or similar material.

Exclusion methods also include the use of netting, custom-designed sheet-metal or plastic covers, to keep birds from roosting on ledges, roof edges, window sills, building signs, and other surfaces favored by pest birds. Modifying flat ledges by the addition of a 45° angle plastic or metal device eliminates the site for roosting or nesting by birds, and is the most effective approach. Two advantages are that the birds are not killed and the management is comparatively long-lasting. Porcupine wire and sticky repellents are not as effective over a long term as they fill with debris (nesting material) or dust and grime.

Netting

Netting is used to block access of birds to large roosting areas in structures. Netting is especially useful in warehouses and around mechanical equipment areas where aesthetics are of minor consideration. It has been used successfully on cooling towers.

Plastic nets are alternatives to metal and fiber nets in bird management. Plastic nets are normally extruded black polypropylene and are made with an ultraviolet inhibitor to reduce UV degradation. Knotted nets are also available. Nets will last from two to five years depending on exposure to sunlight. Use the best quality affordable.

Covers or Ramps

Custom-designed covers for ledges, window air conditioning units, and roof edges are the best technical solution to keep birds from infesting these sites. The cost of this method may deter you from exercising this option on large buildings that have extensive roosting sites. But covers are valid options where limited applications will keep birds off selected sites, and where aesthetics are an important consideration.

The covers usually consist of sheet metal installed at a 45° angle to prevent the birds from landing. Sometimes plastic inserts are custom-fit into the indentations in order to block off ledges.

Plastic or metal 45° angle inserts are now available commercially. These devices become almost invisible when properly installed.

Spikes

Porcupine wire, sharp metal spikes, or any similar "bed of nails" can deter birds from roosting on ledges for a short time. If aesthetics are important, these devices are usually limited to areas where they cannot be easily seen. If birds are likely to drop nest material and other debris on top of the newly installed spikes in an attempt to create a new roosting surface, install metal spikes on potential landing sites above the installation. Check metal spikes every six months for accumulated debris or nest material. Regularly remove falling leaves and other matter that can cover the spikes and reduce their effectiveness. Prune to ensure that no tree branches hang over protected ledges.

Sticky Repellents

Sticky repellents are tacky gels or liquids. The products are designed to be sticky enough to make a bird uncomfortable, but not so sticky that the birds are trapped. The active ingredients can be polybutene, isopolybutene or petroleum naphthenic oils. Precautions should be followed when sticky repellents are used. Be sure migratory or other non-target birds are not harmed. Do not place sticky repellent material where it will become unsightly over time. The disadvantages of sticky bird repellents are so great that they are not recommended for use in urban areas.

Spike, glues and other deterrents become ineffective over time and are unsightly.

Remove Nests

Check state and local regulations that may prohibit destroying or disturbing nests containing eggs or young.

Ultrasonic Sound Devices

Tests by university, government, and private independent researchers have failed to demonstrate any efficacy against birds by any of the ultrasonic devices tested. These devices do not work against most birds.

Trapping

In many instances, trapping can be an effective supplemental measure. Where a group of birds are roosting or feeding in a confined and isolated area, trapping could be considered a useful tactic.

Risks to Non-targets

Most tactics in bird management pose some risk to non-target birds, as well as other animals. All migratory and game birds are considered non-targets, and are protected by various federal, state, and local regulations, as well as by public opinion. Care must be taken to minimize the threat to non-targets or to use tactics that pose the least risk.

First, identify any non-target birds or animals in the area.

Second, use tactics that are least at risk.

Third, modify tactics to minimize risk.

Fourth, monitor operations to be sure that no non-targets are being adversely affected.

Public Relations

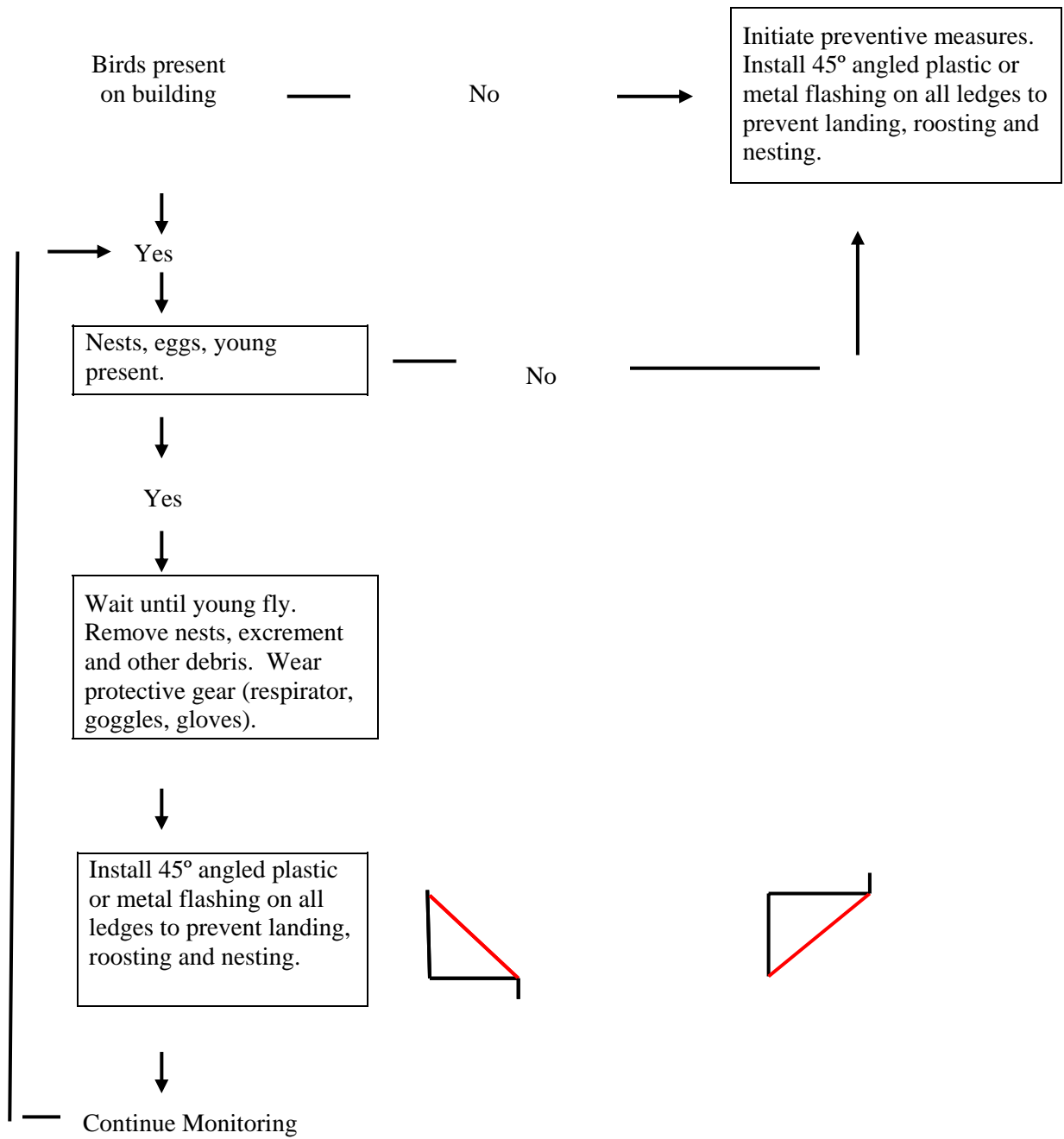
People often react more negatively to one dying bird than to accumulated bird droppings on sidewalks or potential risks of parasites and disease from bird roosts. The public's perception of bird management operations must be considered. All bird management programs should put some effort into avoiding "people problems."

BIRD DROPPINGS REMOVAL AND CLEAN-UP

Workers removing large quantities of bird droppings should follow these precautions to minimize risk from disease organisms in the droppings:

- Wear a respirator that is labeled to filter particles down to 0.3 microns.
- Wear disposable protective gloves, hat, coveralls, and boots.
- Wet down the droppings to keep disease spores from becoming airborne, and avoid drying them out.
- Put droppings into sealed plastic garbage bags and wet down the outside of bags.
- Dispose of trash bags. Disposal should be permissible through standard trash pick-up.
- When finished, and while still wearing the respirator, remove the protective clothing and place them in a plastic bag.
- Wash up or shower.

BIRDS



APPENDICES

APPENDIX I

PEST PROFILES

PUBLIC HEALTH PESTS

FLIES

CHARACTERISTICS AND RECOGNITION

In terms of both numbers and health concerns, flies make up one of the largest groups of insect pests. Although the major features and management measures given here are for urban pest flies, the principles generally apply to all flies.

The main urban fly pests in the United States are the house fly, fruit fly, hump-backed fly, bottle fly, moth fly, and fungus gnat, each of which has very similar life cycles. Adults seek moist garbage, dead animals, or manure in which females deposit eggs. Eggs develop into grub-like larvae (or maggots) that feed on the food source on which eggs were deposited. After a week or so, larvae leave the food source and spend another week or so in a non-feeding, cocoon-like form (pupa) from which adult flies emerge in a few days. Adult flies quickly mate and may move from the breeding site into human occupied structures through open doors and windows, seeking food.

Food for a fly consists of almost any organic material. House flies (among many others) eat solid food by vomiting digestive enzymes onto the food source and macerating it into a liquid form that can be lapped up with sponging mouth parts. Since flies continually vomit and defecate while feeding, germs are deposited on the food they feed on.

HOUSEFLY (*Musca domestica* L.)



House Fly Life Cycle

Worldwide, the common house fly is one of the most widely distributed insect pests. House flies are soft-bodied, gray-colored, about .63 cm (1/4 in) long, and have only one pair of wings that span about 1.5 cm (5/8 in). Their faces have two soft stripes that are silver above and gold below. The upper surface of its thorax is marked with four dark longitudinal stripes, and the abdomen is yellowish-white at the sides and base. House flies are active year-round outdoors in mild weather and indoors during fall and winter.

The housefly rarely moves more than a mile to food from its breeding sites. They have an excellent sense of smell, which leads them to food and water. Their range of vision is about eighteen inches. They are attracted to red colors.

Over her lifetime, a female house fly will lay from 350 to 900 eggs in any moist excrement, garbage, decaying fruit, vegetable waste, and soil containing organic matter. After eggs hatch, larvae feed and eventually migrate to cool sites (for instance, soil beneath boards or stones), where they pupate. In three days to four weeks, depending on temperature and humidity, adult flies emerge from pupae. Normal adult life span of the house fly is two to three days if denied food, but flies live up to 54 days when food is present. The time from egg to adult ranges from seven to 45 days, and in warm weather two or more generations can be produced per month. House fly populations may be greatest in early fall (September and October). Because larval

house flies produce a glycerol compound, which keeps their body fluids from freezing, they mostly over-winter as maggots or pupae. Various similarities in appearance and behavior make it important to be sure that suspected "house fly" problems are not really flesh fly problems, which originate with dead animal carcasses.

FRUIT FLY (*Drosophila spp.*)

Fruit flies, also called vinegar gnats and pomace or vinegar flies, are made up of a number of



Fruit Fly with Egg

species with worldwide distribution, and are the most common of all small flies. They are .3 to .63 cm (1/8 to 1/4 in) long, dull yellow to dark-brown, and some kinds have distinctive bright red eyes. Fruit flies are small enough to pass through window screens with a mesh size larger than 12 per inch. Fruit flies breed in such decaying matter as juices or other liquids remaining in empty cans, ripe fruits and vegetables, drain slime, wet mops, and dumpsters.

Female fruit flies lay from 400 to 1,000 eggs on the surface of decaying organic materials and in garbage cans; some species prefer briny or vinegary liquids around jar lids. Larvae hatch within 30 hours and begin to feed near the surface of the food source. Mature larvae move into dry areas to pupate, and development is completed in nine to twelve days. Outside, fruit fly numbers quickly build in summer until populations peak during fall harvest. Fruit flies can be present year round, especially indoors where preferred foods and breeding sites are available. Fruit flies are able to quickly reproduce in large numbers and may contaminate food if not managed.

MOTH FLY (*Psychodidae*)

Moth flies - or drain, moth, filter, and sewer flies or sewer gnats - are generally found in drains,



Moth Fly

especially in kitchens or bathrooms. Adults resemble moths, and are about .3 cm (1/8 in) long. They have light gray, tan, black, or brown bodies, and lighter colored wings that are held roof-like over the back when at rest; both body and wings are covered with long hairs, giving the body a fuzzy look. Moth flies are poor fliers and are most commonly seen just walking or running along walls. Their flight is short and jerky and of short duration (a few feet). Some species are active in winter.

Moth flies breed in similar material to fruit flies. Females lay masses of eggs, especially between loose floor tiles in wet areas, in drain pipes, dirty garbage containers, water traps, and plumbing fixtures, around built-in sinks, and near decomposing organic matter. Larvae (maggots) develop in shallow, polluted water and feed on sediments, decaying vegetation, and microscopic plants and animals found in gelatinous drain film. The life cycle is usually two to

three weeks but may be as short as one. Adult moth flies emerge from sink, tub, shower, and floor drains. Some species are small enough to pass through window screens. Moth flies are mostly active in the evening, around drains or sinks. Moth flies do not bite and are of little health significance.

HUMP-BACKED FLY (*Phoridae*)



Hump-backed Fly

Hump-backed flies, or phorid or coffin flies, are .15 to .3 cm (1/16 to 1/8 in) long and similar in appearance to fruit flies, except that they are more humpbacked. Most species are brownish-yellow with brown wings, a small head, and a large and humped thorax. Larvae are whitish, legless, and worm-like and feed on sewage, dead animals, insects, rotting plant material, animal feces, and open wounds.

They infest clogged drains and dirty garbage containers, and adults are attracted to light. These flies are active in buildings during winter. Hump-backed flies have strong legs and are reluctant to fly. They are seen running across surfaces in quick and jerky motions. Hump-backed flies can infest building complexes.

Hump-backed fly adults and larvae are common around decaying vegetation (mold and organic matter). They can penetrate several feet into the soil to infest animal carcass or organic waste. Flies emerging in large number inside a structure may indicate plumbing leaks in the crawlspace or beneath floor slabs, and considerable effort may be required to locate the hidden wet breeding areas attracting them.

FUNGUS GNAT (*Sciaridae* or *Mycetophilidae*)



Fungus Gnat

Adult fungus gnats are .3 cm (1/8 in) long and resemble small mosquitoes, except that they do not bite. Fungus gnats are readily identified by their small size, distinctively long legs, and pointed abdomens. Adults are not strong fliers and are seen running across soil surfaces as potted plants are watered. Adults are also attracted to light, and collect at windows. Larval fungus gnats are worm-like, about .63 cm (1/4 in) long, have a transparent body and dark head, and are usually found in the top layer of damp potting soil.

Outside, fungus gnats are usually found in gardens, where some larvae live near the soil surface, and others are deeply buried where they feed on plant roots. Fungus gnats reproduce all year long indoors, and the life cycle is 12 to 27 days, depending on temperature.

Over-watering of potted plants supports fungal growth. Larvae thrive in dampness, decaying vegetation, and outdoor compost. These flies do not generally damage plants.

BLOWFLY OR BOTTLEFLY (*Calliphora* spp., *Phaenicia* spp.,)

A number of blowflies - blue, green, and black blowflies or bottleflies - are common throughout the United States and may enter dwellings where they are attracted to windows. Blowflies are common in populated areas, especially near slaughter houses, meat-processing plants, and garbage dumps. Blowflies are usually the first flies to appear in spring, sometimes emerging from hibernation on warm, sunny winter days. Blowflies mainly invade buildings during cool weather, when they are readily attracted to garbage cans. At night blowflies rest on shrubs or building walls from which they can easily enter buildings when doors and windows are left open.

Blowflies are found in trash compactors and chutes, compost piles, on the ground, and in wall voids, attics, and chimneys. Blowfly larvae are sometimes observed on floors or falling from ceiling fixtures.



Green Bottlefly

Adult blowflies are primarily scavengers. They are larger than house flies, make annoying buzzing sounds, and have metallic blue, green, or yellow or brown-colored bodies. Blowflies range in size from .79 to more than 1.27 cm (5/16 – 1/2 in) long and have a single pair of wings. Females usually lay 200 to 700 eggs (one species, up to 3,000 eggs) on meat, dead animals, decaying plant matter (such as lawn clippings), solid animal waste (dog manure is preferred), or at the edge of wounds in living animals. They can produce more than 30,000 flies per week.

Larvae are large and develop fast; they feed for up to ten days on the surface of decaying matter and, when larger, burrow into less decayed areas. When mature (about 1.90 cm [3/4 in] long), larvae wander away from the food source and burrow into the ground to pupate. In one to three weeks they emerge as adults. The time from egg to adult in some species is only nine to 18 days, which allows four to eight generations per year. Some species over-winter in the soil as full-grown larvae, and others hibernate in attics, walls, and ceilings, but not in clusters. The life cycle is from two to four weeks. The presence of either adults or larvae in a structure indicates the presence of dead animals (usually rodents) or rotting organic matter.

CLUSTER FLIES (*Polenia rudis* [Fabricus]) (North America)



Cluster Fly

Adult cluster flies are about .9 cm (3/8 in) long, stout, and have a dark grey thorax with short golden hairs. The abdomen has irregular lighter portions. The adult flies often enter structures in the fall as days shorten and the weather cools. They overwinter in attics and wall voids, forming compact clusters of flies. They usually inhabit the side of the structure that gets the most sunlight. The adults overwinter in sheltered places and emerge in spring to mate. Eggs are deposited in soil and hatch after about three days. The hatched larvae search and enter earthworms as parasites. From

egg to adult takes 27-39 days, depending upon temperature; which produces about four generations a year. Cluster fly adults are relatively sluggish in movement.

HAZARDS OF INFESTATION

Flies in General

Flies provide great potential for disease transmission because of their feeding habits. Along with mosquitoes, flies are responsible for spreading serious diseases like malaria, sleeping sickness, leishmaniasis, and filariasis. Other disease-causing organisms that have been collected on flies include germs causing dysentery, tuberculosis, cholera, tularemia, anthrax, poliomyelitis, yellow fever, and typhoid.

Houseflies

Houseflies alone transmit more than 20 human diseases and parasitic worms (including salmonella, typhoid and paratyphoid fever, cholera, summer and infantile diarrhea and dysentery, tuberculosis, and anthrax) which adhere to the fly's sponging mouth parts, sticky foot pads, wings, body surface, or live within the fly's gut.

Blowflies

Blowflies deposit eggs on meat which, when eaten, are responsible for cases of intestinal myiasis (caused when live fly larvae are accidentally ingested, causing nausea and other conditions similar to food poisoning).

Eye Gnats

Eye gnats are suspected transmitters of conjunctivitis.

Cluster Flies

Overwintering cluster flies in attics and wall voids have substantial mortality. The dead flies in their typical clusters become a food source for dermestid beetle larvae. The dermestid beetle larvae can then become a source of infestation of historic organic artifacts in museum collections.

IDENTIFICATION, INSPECTION, AND MONITORING

Identification

If it is difficult to identify flies, request assistance from state health departments or preserve flies in alcohol and send them to university departments of entomology when necessary.

Inspection

Do not stop inspecting after finding the first breeding site, nor concentrate efforts only on those areas where flies were seen. Seek out all possible places which could contain decaying material, garbage, rotting fruits, vegetables, meats, dead animals or grass clippings. When inspecting for fly-breeding sites, first search for wet areas: floor drains, open drums, buckets, cans, bottles, potted plants, dish washers, machinery, and around cracks, roof lines, and loose tiles. Look for moist animal feces, garbage, wet mops, and towels. Housefly maggots on floors or pupae under carpets signal the probability of fly-breeding sites inside the building.

Begin inspections outside by intensively searching for breeding sites, first concentrating on garbage and refuse areas. Look under equipment for maggots in dead animal carcasses (mice, trapped animals, dead rodents), and in garbage and drain sludge. Examine building cracks and crevices, dumpsters and garbage cans, drains and refuse piles. Cat, pigeon, and rodent feces and dead rodents are ideal breeding sources. Develop maps of likely breeding sites and periodically re-check those areas for live fly larvae.

Inside the building, inspect trash container interiors and areas prone to litter (such as break rooms and lounges). Look for empty soda cans, coffee cups, rotting fruit products, misplaced lunch bags, wet towels, and debris in locker and lounge rooms. Inspect all cracks at baseboard level, crevices around loose floor tiles, hollows and voids, and inaccessible areas in machinery that are caked with dirt and organic matter. Inspect potted plants and grease traps.

In kitchens and food processing areas, thoroughly search for decaying food. Inspect floor drains, floors under work counters and equipment, and enclosed counters which permit water or food to accumulate inside or beneath them. Look under ovens, and in both hard-to-reach and under clean machinery at floor level

General Monitoring

Houseflies have certain preferred resting places. During the day and when not feeding, adult flies may be found resting on floors, walls, ceilings, in crack and crevices, and other interior surfaces as well as outdoors on the ground, fences, walls, privies, garbage cans, clothes lines, and vegetation. To monitor for adult flies, place scatter grids out for 30 seconds (or other standard time limit) in locations near preferred resting places and count the numbers of flies landing on grids. Sticky tape, 6.62 x 12.70 cm (3 x 5 in) wide sticky paper, or sticky strings can also be used to monitor adult flies.

When problem flies are attracted to light (for instance, cluster and hump-backed flies), place light traps in dark places or capture flies at windows. Use monitoring information to establish levels of infestation upon which to base management actions.

Monitoring Information on Specific Kinds of Flies

Housefly

Sticky or light-trap monitoring which produces, on the average, 50 to 75 house flies per trap per day indicates a moderately heavy population. More than 150 house flies per trap per day indicate a heavy population.

Drain Flies

To find possible entry points of drain flies:

- Place sticky traps near suspected sites;
- Set clear glass or plastic containers over drains or tape plastic bags over drains to capture emerging drain flies;
- Fit a piece of fine screen over the drain to see if drain flies stop appearing;
- Scrape a pocket-knife blade around the film inside the drain and look for tiny, worm-like drain fly larvae;
- Look for points of drain fly entry through cracks in the slab or expansion joints on the floor to suggest sewage-soaked soil or broken sewer lines;

MANAGEMENT

Mistakes in Fly Management Programs

The following are the most common mistakes made in fly management programs:

- Failure to properly identify flies and to find and correct conditions providing breeding sites.
- Stopping after finding the first breeding site; all possible breeding sites must be discovered and eliminated.
- Trying to manage adult flies without first managing larval breeding sites. Management of adult flies may be helpful to alleviate complaints, but it is not as effective as managing larval breeding sites.
- Attempting to manage flies with only pesticide chemicals. Pesticides alone will not eliminate fly problems and are only effective when good sanitation and exclusion are practiced as primary steps.

Physical, Mechanical, Cultural Measures

Sanitation

General: The first step in any successful fly program is to reduce fly numbers; the key to that is an effective sanitation program for potential breeding sites.

Outside:

- Eliminate conditions responsible for fly-breeding sites around buildings by properly disposing of food materials and garbage (especially under dumpsters), preventing accumulations of moisture, and removing weeds.
- Do not throw waste water from cleaning operations onto the ground; pipe it into covered drains. Keep areas around garbage cans clean. Assure that tight-fitting lids on garbage receptacles are used.
- During warm weather, steam-clean and rinse out garbage cans and dumpsters with disinfectant solutions on a weekly basis.
- Be sure that garbage is picked up twice weekly so larvae will not have time to develop into adults.
- To assure that fewer flies will enter structures, keep garbage cans and dumpsters tightly closed and as far from buildings as possible.
- Keep dumpster bottoms as dry as possible by installing bottom drains and lead water drainage into sewer systems.
- Release fly parasitoids (*Pteromalidae*) near areas where flies may pupate to prevent adult fly emergence.
- Seal cracks and crevices that lead to the inside to prevent adult cluster flies from entering.

Inside:

- Fit garbage cans and dumpsters with tight-fitting lids and always keep receptacles closed.
- Routinely clean cans and dumpsters with disinfectant solutions.
- Seal all wet and dry garbage up in plastic bags before placing it into receptacles; this excludes flies and reduces both odors and the attractiveness of garbage to flies. Be sure to take garbage out every night.
- Keep floors, walls, cooking, and food-preparation surfaces clean and dry.
- Examine plumbing pipes for possible leaks and water condensation.

Notes on Management of Specific Flies

Housefly: Housefly management requires a fully integrated approach based on exclusion and improved sanitation. Reliance on pesticides usually fails in the long-term since house flies have developed resistance to most pesticides.

Fungus Gnats: Allow potted plants to dry out between waterings. Remove potted plants if they supply fly food, water, or harborage sites.

Fruit Flies: Management of fruit flies first requires that sources of infestation be removed. This is often difficult because fruit flies feed on a wide array of organic materials, much of which may be well concealed behind plumbing, in janitorial closets, stagnant drain traps, bottoms of garbage cans, and cracks, under appliances or counters, or outside the building. Unless thorough sanitation is practiced to achieve fruit fly management, problems continue to develop.

Drain Flies: Finding and removing breeding sources and good sanitation practices are the only permanent solutions for drain fly problems. Use a brush and industrial cleaner to remove slime and film from drains and flush drains with hot water and commercial caustic drain cleaners or disinfectants. Check carefully under the crawl space for leaks or water backups from possibly broken garbage disposal or sewer pipes. Inspect such other possible breeding sites as clogged roof gutters, air conditioners and cooling towers, clogged storm drains, septic tanks, loose floor tile, water beneath potted plants, rain barrels, sewage treatment plants, dirty garbage cans, and moist compost piles.

Hump-Backed Fly: The presence of hump-backed flies most often indicates that plumbing is leaking. Hang yellow sticky traps in various places in the room to show where flies are entering, or tape a plastic bag over suspected floor drains. Hump-backed flies are attracted to light, and windows are a good place to collect them. Electric-light traps can also be used in dark areas where there is no other source of light. Once found, eliminate larval food sources (there may be more than one). If broken pipes are found, excavate and discard and replace all gooey soils saturated with organic material. Ventilate and dry out areas so as not to support insects.

Cluster Fly: A vacuum can remove clusters of the adult flies as they are found overwintering. Killing them with a pesticide may leave behind (unless removed) the bodies in an inaccessible void where dermestid larvae can feed upon them. In June or July, when all live adults have left the structure, screen all vents, weepholes and overhangs with at least 16 mesh screen. Caulk all openings, cracks, crevices, cable entrances, windows, doors and other potential entrance points. Cluster flies are attracted to lights.

Exclusion

Exclusion is second only to sanitation in effective fly management programs, because flies are always attracted to the warmth and odors of buildings.

- Assure that all doors, windows, air curtains, and door closing devices are in good repair and maintained to keep flies from entering the structure. Fit windows and doors with 16 mesh-to-the-inch, tight-fitting screens and install self-closing door devices.
- Screen doors should open outward; double sets of screen doors may be required.

Other Management Methods

Heat: Flies die in 30 minutes when exposed to 49°C (120°F) dry heat.

Vacuum: A vacuum may be used to collect flies in groups (such as cluster flies).

Sticky traps: The best place to put sticky traps is where flies usually rest: in corners, on edges, on thin objects (suspended wires or strings), and on ceilings. Sticky paper and sticky strings are useful to capture house-flies, but flies are also trapped when encouraged to light on cotton balls.

Live-Capture Fly Traps: Outdoor, mechanical, and food-attractant fly traps are useful in some locations to lessen fly numbers, but they require attractive fly bait.

- Home-made fly trap: Place one cup of sugar, one cup of vinegar, and one banana peel in an empty two-liter bottle; fill with water to within 10.16 to 12.70 cm (4 to 5 in) from the top; tie a heavy cord around the neck to hang it from a tree. This trap catches flies all season long.
- Fruit-Fly Trap: For fruit flies, use "fly-in" type traps having specialized saucer-like lids that fit a quart-size mason jar. Bait these traps with a 2.54 cm (1 in) piece of freshly sliced banana and add one teaspoon of water to keep the banana moist. Replace the banana every two to three days. In areas of high infestation, a trap may become filled with fruit flies in less than 24 hours. In kitchens, place traps out of sight and covered with paper. To kill flies before removing them from the trap, run hot water (66EC [150°F]) into one of the entry holes. Keep the outside of the jar clean and dry, or fruit flies will feed on the outside and not enter the trap. Since fruit fly eggs hatch in 10 to 15 days, clean the jar every two to three days. Meanwhile, carefully inspect the building to find the source of the flies.

Insect Light Traps

Electric and ultraviolet (UV) insect light traps (ILTs) offer good captures when used according to manufacturers' directions. Correct use of ILTs can help solve many flying pest problems in small facilities. Proper maintenance of ILTs requires annual (or more frequent) lamp replacement, weekly trap cleaning to manage dermestid beetle problems, and a sufficient number of properly located traps. Locate traps three or more meters (12 or more feet) from doorways so flies cannot see them from the outside (to prevent attracting flies into the building), less than 1.52 meters (5 ft) from floor level, and at ceiling level in front of large overhead doors, but not facing outside. Each situation is different and it should be determined in advance how flies enter and move through a building. Clean light-trap trays often, both to monitor efficacy and to prevent scavenger insect problems.

Outside Lighting

If practical, place outside lamps on poles away from buildings but shining onto doors, so as to attract night-flying insects away from the building. High-pressure sodium-vapor lamps help to minimize flies when installed at, but not over, entrance ways.

Temperature

Flies become sluggish or do not fly in lower temperatures. Keep inside temperatures as low as practical.

Other

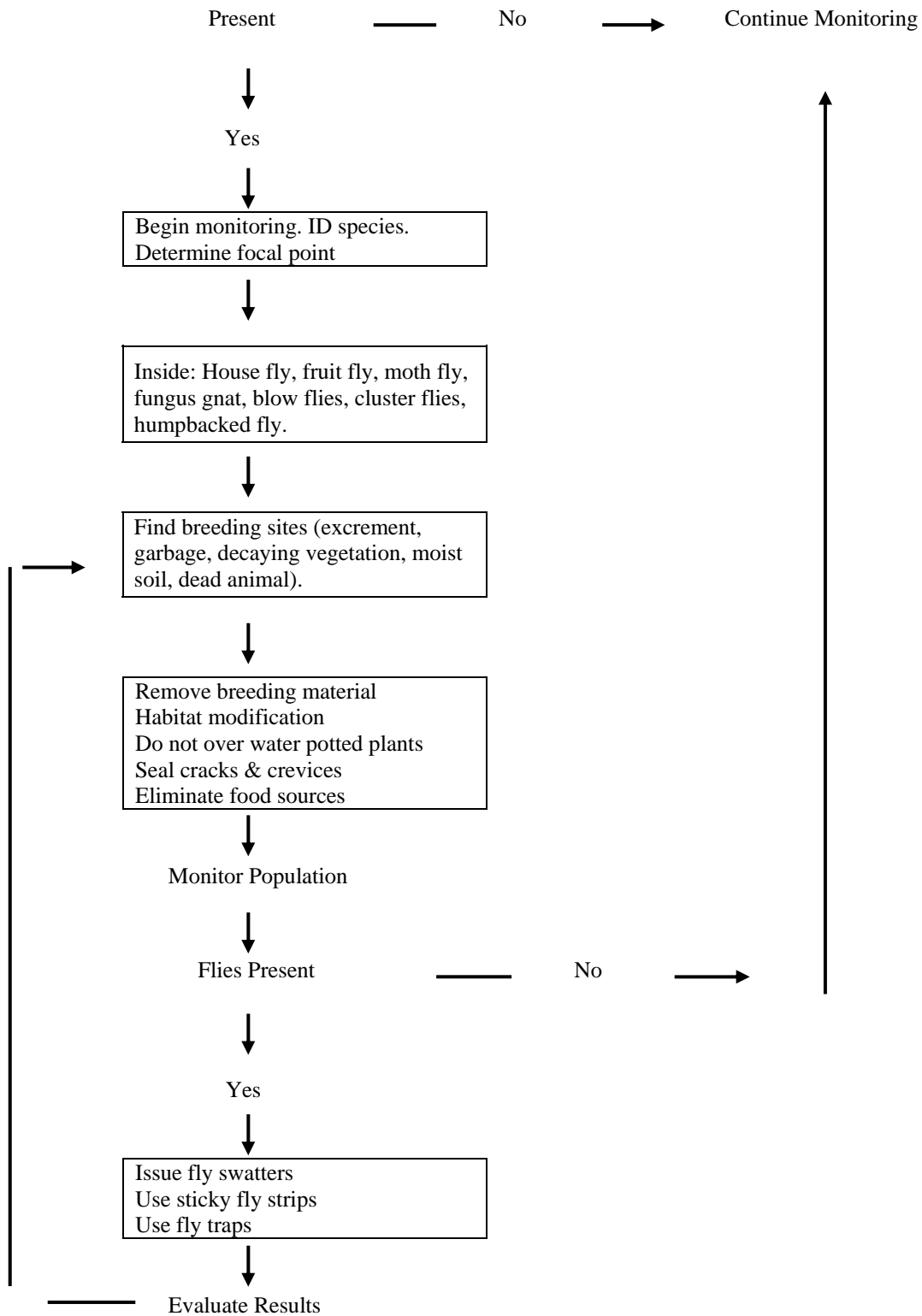
Fungus gnats: Where fungus gnats are a problem inside, stir soil of potted plants so it will dry out. Allow soil to dry out between waterings (just until plants begin to show very first signs of wilting). Discard dead plants, rotting vegetation, and infested soils. Pot new plants and transplants only in sterile potting soil. Store unused soil separately in a covered container where it cannot become infested. Hang yellow sticky cards (used by the greenhouse industry) above the plants; this will also help control white flies and other plant pests.

PESTICIDES

When deemed necessary, pesticide applications shall be performed by approved licensed applicators only. Applications shall be made according to National Park Service policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

Pesticide applications for flies are generally unnecessary since sanitation, cultural controls and exclusion will reduce or eliminate fly infestations in structures. Do not treat for cluster fly in attics or wall voids.

FLIES

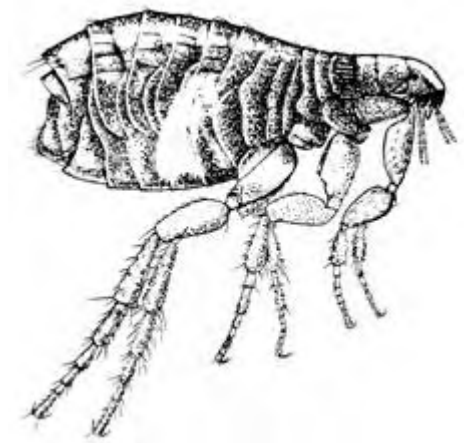


FLEAS

CHARACTERISTICS AND RECOGNITION

Fleas are common indoor problems throughout the United States, except in very dry areas. The most typical species, and the one used here as a model for flea management, is the cat flea. It feeds on a number of hosts, including cats, dogs, rodents, opossums, etc., and is found in a wide range of environmental conditions. This flea prefers animals but also affects people. Some conditions may encourage large numbers of fleas because:

- Summertime provides optimum temperature and humidity for flea-growth;
- After an absence of a host, large numbers of emerged and emerging adult fleas are ready to feed on any warm-blooded host.



Adult cat fleas are about .3 cm (1/8 in) long, have sucking mouthparts, and exclusively feed on a host's blood. Flea bodies can withstand substantial pressures. Egg production in females begins two days after her first blood meal and peaks about the fourth day. She produces from 150 to 400 round, light colored eggs, the size of a fine-point pen tip, and lays about 20 of them per day for up to three weeks. Since about half of the fleas on an animal or pet are female, up to 500 flea eggs per day can drop onto turf and other resting areas in a site. Larvae hatch in two to fourteen days and then move to the base of turf or other fibers seeking food.

Cat Flea

Larvae of cat fleas are also .3 cm (1/8 in) long, have chewing mouthparts, and feed on adult flea feces (which are partly digested blood), and organic debris. They must have a source of dried-blood or blood-containing materials to be able to complete the three necessary molts of larval development. Cat flea larvae are not very mobile. They are usually either in the animal's resting areas or protected spots. They shun heat, sunlight, and decreased humidity but are attracted to moisture. When molts are completed, larvae spin a sticky silken cocoon within the substrate and pupate. When pupal development is complete, they become adult but may remain within the cocoon until some stimulus triggers their emergence: for instance, being stepped near by an animal, carbon dioxide exhaled by a host, vibrations, or increased temperature and humidity. Most adult fleas emerge from pupal cocoons in ten to fourteen days; adult fleas can remain in the pupal stage cocoon, inactive but ready to emerge, for as long as a year while waiting for the proper host stimulus.

Flea larvae and pupae are mostly found in undisturbed areas which provide optimum humidity and temperature, regularly visited by animals and contain larval food. Fleas may be imported into structures by pets or squirrels entering the house through chimneys or other openings.

HAZARDS OF INFESTATION

Typical flea bites show as a central, small red spot where flea mandibles penetrated the skin, surrounded by a red halo. Some animals may be allergic to flea bites which may be seen as dermatitis, hair loss, excessive scratching, and skin inflammation.

INSPECTION AND MONITORING

Inspection of Buildings

Conduct a close inspection of the living unit to find "hot spot" areas with flea development.

- Look under furniture, in rugs, etc. for granules resembling salt and pepper which indicate flea presence. These salt-and-pepper granules are made up of flea feces, empty egg cases, shed larval skins, and dried blood.

- Collect fleas and have them identified. Fleas can be trapped in a number of ways:

Collect fleas that land on an inspector's long white socks after a one-minute walk-through of flea-infested areas.

Collect fleas from pet bedding, or by combing infected animals with a flea comb; place fleas in a plastic bag and kill them by freezing or heating to 49°C (120°F).

Use commercial flea traps available from pet-supply dealers.

- Watch for animals going into yards or under dwellings. Look for bird or mammal nests under the structure and in unscreened chimneys and pipes. Opossums carry large populations of cat fleas, which may subsequently infest areas they travel through.

MANAGEMENT

Major Mistakes in Flea Management Programs

The effectiveness of flea management programs can be diminished by:

Failure to identify fleas and find the source of the problem;

Failure to exclude animals bringing fleas into the site;

Failure to clean indoor areas where fleas find harborage; failing to instruct occupants on cleaning methods;

Failure to gain occupant cooperation or inform them of what to expect after treatment -- because of the flea's life cycle, a few adult fleas will be seen after treatments;

Physical, Mechanical, and Cultural Measures

Sanitation

Thoroughly vacuum in a criss-cross pattern all flea "hot spots" and other areas used by animals (rugs, sofas, drapes) with a strong vacuum cleaner. Vacuuming can remove a large percent of the flea larvae present and flea eggs. Good vacuuming can keep a flea population low. Removal of flea larvae from carpeting is the most important action in reducing an indoor infestation. Carefully dispose of sealed vacuum bags containing live fleas.

If possible, lower the relative humidity in the structure to less than 50%.

Remove vegetation near the structure that may provide rodent harborage.

Exclusion

Screen vents, crawl spaces, and chimneys to keep animals out from under structures, outbuildings, or chimneys.

Ultrasonic devices have not been shown to be effective for flea control.

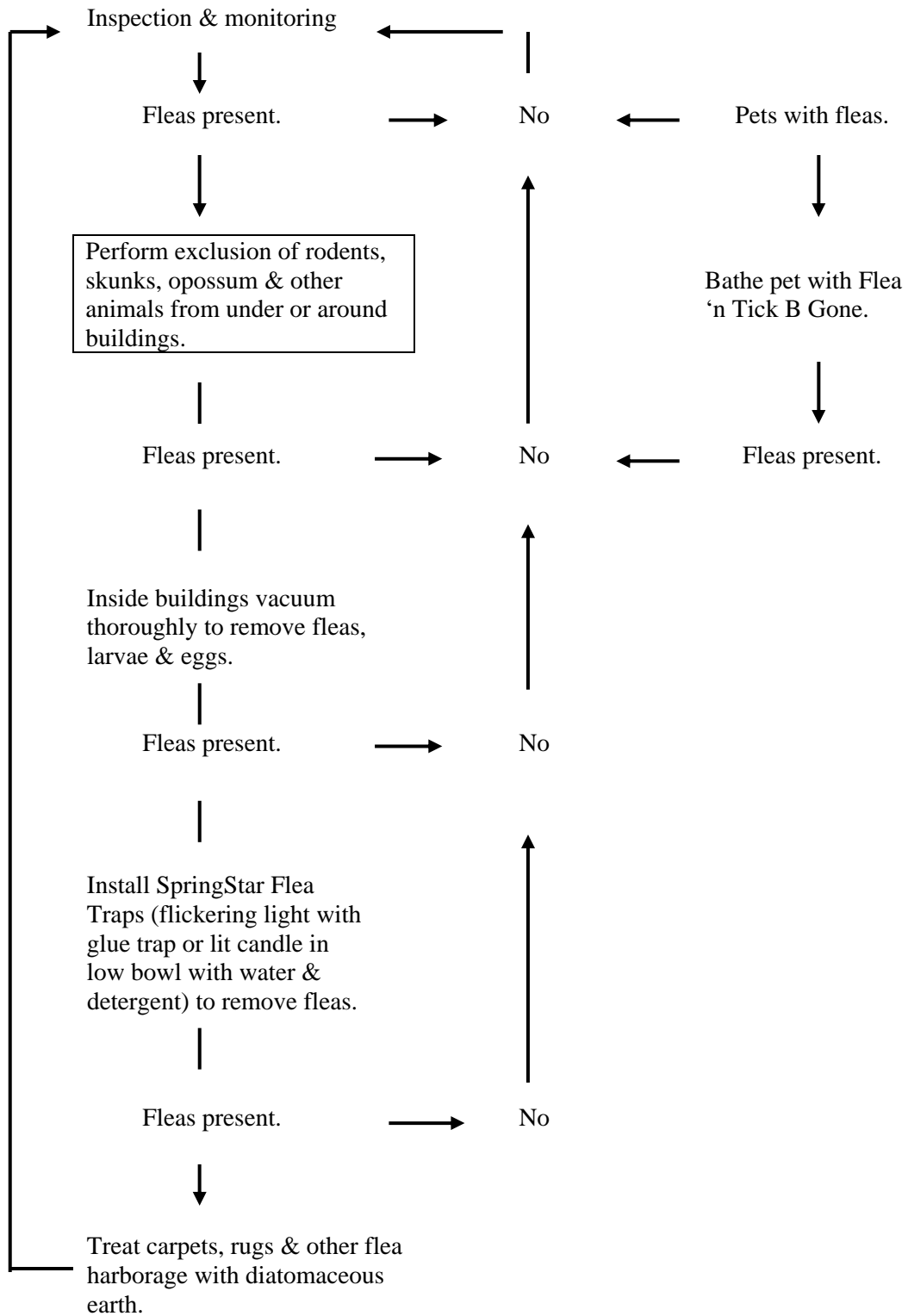
Fleas are killed in dry or moist air temperatures of 43 °C (110°F).

Pesticides

Pesticides alone will not eliminate flea problems. The management should be with combined physical and mechanical means. The following are additional items for flea management:

- If low-risk, enzyme products such as Flea and Tick B Gone are used on pets such as dogs; there is no need to wear protective equipment.
- Insect-growth regulators offer best results when used before spring flea activity begins. Follow label directions.
- Commercial, non-pesticidal flea soaps may also be effective against fleas; bathe pets with flea soap according to the label.

FLEAS



WASPS AND BEES

CHARACTERISTICS AND RECOGNITION

General

There are thousands of different kinds of wasps and bees in North America, most of which are small wasps that are parasitoids of other insects and solitary burrowing bees. However, there are only 50 or so species of stinging wasps and bees that are troublesome to people. These are generally divided into two groups: the social wasps and bees (including hornets, yellow jackets, umbrella wasps, and honey bees); and the solitary wasps and bees which include mud dauber wasps, cicada killer wasps, and carpenter bees.

Social wasps and honeybees build nests in and around structures. Typical nest sites include beneath eaves, on porches, behind blinds, in trees, shrubbery, and vines, in stone walls, and in the ground. Most of the social wasps prey on destructive insects (house flies, blowflies, caterpillars, and moths) that they feed to their young (larvae). From this standpoint, they are considered beneficial. Honey bees gather nectar from flowers and convert it into a thick viscous liquid we call honey, which is fed to both adults and larvae. Solitary wasps prey on insects they paralyze and place, along with eggs, into individual nests. After the eggs hatch, the larvae feed on those insects until they can emerge from the nest.

Social Wasps

Social wasps live in colonies that have a caste system (division of labor) with overlapping generations, and a single fertile reproductive female called the queen produces all offspring. The other two adult forms in social-wasp colonies are the fertile males that mate with queens and the female workers, which are sterile. Their social colonies may persist for many years, unlike other stinging wasps which start anew each year.

All social wasps develop in similar ways. In the autumn, queens and males leave the nest to mate. The males die after mating, but the queens hibernate over winter in some protected area such as a crack, under tree bark, in buildings, attics, and basements, or in a hole in the ground. Next spring, the queens come out of hibernation, find a suitable nest site, construct simple, small, paper-like nests made from masticated wood and plant fibers mixed with water, and lay 25 to 70 eggs. The queen will not lay more eggs until that first brood has matured. Larvae hatch in a few days and glue themselves into the cells. The queen will feed the larvae chewed up bits of insects over the next 12 to 18 days until larvae mature. When mature, larvae spin a silken cap to close the cell and pupate (undergo metamorphosis into an adult). Once the first brood emerges as adults, the queen resumes egg-laying. Subsequent larvae produced by the queen are fed by the first generation of workers who also expand the comb or nest. The queen and workers do not eat the insects they collect for larvae. They subsist entirely on flower nectar and a sweet liquid provided by larvae when fed. With the onset of cold weather, wasps abandon the nest, which

disintegrates from actions of weather, birds, or squirrels. The only member of the colony that over-winters is the fertilized queen.

Although yellow jackets and umbrella wasps are closely related and have similar life histories, their nest-building habits differ.

Umbrella Wasps



Umbrella Wasp & Nest

The nest of the umbrella wasp best demonstrates a basic building pattern. Nests are made of paper-like material produced by the wasps, but appear as a flattened, circular-shaped comb of cells opening downward.

These are initiated by the umbrella wasp queen, which starts the nest with a thick paper-like strand attached to an overhanging structure, then adds a small number of cells.

Umbrella wasps are slender, elongated wasps, about 1.9 to 2.54 cm (3/4 – 1 in) long. They are black, brown or red with a few yellow markings. An umbrella wasp nest usually contains less than 250 individuals.

Hornets and Yellow Jackets

Hornets and yellow jackets build two different kinds of nests.

Aerial Nest Builders: Aerial nest builders include hornets and some yellow jackets, which build large football-shaped nests from paper materials similar to those of the umbrella wasp. These nests do not consist of a single, flat comb like that of the umbrella wasp, but contain from four to six wide circular combs, one hanging below the other, and all enclosed in an exterior multi-layer oval paper envelope which provides insulation. These nests are usually found on branches of trees, in shrubbery, and on gables. Hornet nests may only contain 500 to 600 workers, but yellow-jacket nests can support up to 10,000 individuals.



Bald Faced Hornet Nest

Underground Nest Builders: Underground nest builders include other yellow jackets that place a protected nest in a natural ground depression, rodent or animal burrow, or into building wall voids, attics, hollow trees, and other enclosed spaces instead of in the ground.



Yellowjacket & Underground Nest

Once workers begin to care for the nest, they enlarge the entrance hole and try to expand the nest. Combs are placed in tiers, one above the other. Nests can become very large and contain up to 15,000 individuals.

Hornets and yellowjackets are black with yellow or white markings and are more compact appearing than umbrella wasps.

Hornet and yellowjacket queens measure about 1.9 cm (3/4 in) long. The males and workers are about 1.27 cm (1/2 in) long. These wasps are feared because they sting. Populations are at a peak from late July to late September. Hornets and yellow jackets become more aggressive and easily irritated in the fall as the colony becomes old and there are fewer larvae to provide foraging adults their "sugar hit."

Solitary Wasps and Bees

Solitary wasps and bees do not build large social nests. The female digs a hole in the ground, tunnels into wood, or builds a nest out of mud. She then constructs a cell or group of cells into which she deposits eggs, provides them with a food source (pollen, or paralyzed insects), and abandons the nest, leaving the young to hatch and mature on their own.

Mud Daubers

Mud daubers are slender wasps, about 1.9 – 2.54 cm (3/4 – 1 in) long. They are black and yellow, metallic blue, or shiny black, and do not sting unless provoked. Their nests are long clay cells placed in such protected places as electric-motor housings, stored machinery, sheds, outhouses, attics, on building siding under overhangs, and under porch ceilings. Occasionally, wasps construct their nests on painted surfaces, which may create an added burden of repainting the area after the nest is removed. Mud daubers stock their clay nest tunnels with a paralyzed spider, caterpillar, or other insect. Then, inside a silken cocoon, they deposit a fertilized egg on the prey and close the nest hole. The egg hatches and the larvae feed on the prey.



Mud Dauber

Adults emerge in the spring. In the fall and spring, abandoned nests often house carpet beetle larvae that feed on residual organic debris in the open clay tunnel. Indoor carpet beetle infestations have been traced to abandoned mud-dauber nests.

Cicada Killer Wasps



Cicada Killer Wasp



Cicada Killer with Cicada

Cicada killer wasps are very large (2.84 – 4.04 cm [1 1/8 – 1 5/8 in] long) solitary wasps with a black body. The first three abdominal segments are marked with yellow across the thorax, similar to smaller yellow jackets. Legs of the cicada killer wasp are yellowish and wings are brownish. Adult cicada killer wasps feed on nectar. In late summer, the female digs a conspicuous burrow (nest) in the ground (often in lawns or gardens) that has a horseshoe-shaped mound of dirt at the entrance. Burrows may be one inch to 3.81 cm (1 1/2 in) in diameter, .61 – 3.05 cm (2 – 10 in) under the surface of the ground, and up to 45.72 cm (18 in) long. The female constructs three to four cells at the end of the tunnel, which she stocks with a paralyzed cicada or two, and then lays an egg in each cell. After eggs hatch, larvae feed on the cicada. Mature larvae hibernate over winter in the burrow, pupate in the spring, and emerge as adults from late July to August.

Although cicada killer wasps are helpful in reducing cicada populations, they frighten people because of their large size and the number of wasps frequenting attractive egg-laying sites. Male cicada killer wasps guard the burrows. Although they may aggressively fly at an invader, they do not sting. Females rarely sting, usually only if provoked.

Carpenter Bees



Carpenter Bee

Carpenter bees are smooth and shiny solitary bees with a mostly black abdomen. Carpenter bees are similar in appearance to bumble bees, but lack hair on the dorsal side of the abdomen, except on the first segment.

They bore into wood to make a tunnel in which they lay eggs and supply developing young with pollen. The tunnel is divided into cells where the individual larvae develop. The tunnels bored by carpenter bees may cause structural damage to buildings where they nest. Typical nesting sites in a structure include fascia, window trim, eave areas, rafters, wood shingles, wood siding, patio

furniture and exterior wood trim. Although many different types of wood are selected for nesting sites, softer woods are preferred. Additional damage to the structure can be made by woodpeckers as they bore into the wood to feed on the developing larvae.

Honey Bees

Honey bees make social colonies of up to 60,000 individuals that live through a number of seasons. Individuals survive the winter by clumping together into a tight group to conserve heat and feed on honey collected and stored during the preceding summer. The number of individuals



Honey Bee

in a honey-bee colony increase during the spring nectar flow (flower bloom) and the members develop a queen cell. Before the new queen hatches, the old queen and about half of the bees leave (swarm) the colony and establish a new one in a protected hollow tree, rock void, attic, or building void.

Both the original and new colonies increase in number over summer and swarm again the next spring. Africanized or “Highly Defensive Bee” colonies have the same life cycle as the European honey bee in the United States, except that

Africanized honey bees produce less honey during summer and the colonies swarm much more frequently. Wild (colonies not housed in hives) honey-bee combs appear as long, hanging tiers of cells joined together at the top and made from wax that worker bees produce.

HAZARDS OF INFESTATION

Hazards

Yellow jacket problems develop in August or later, when their populations and nest activities are the greatest. Yellow jackets are extremely aggressive wasps and, when stinging, release odors that further enrage the entire colony.

When disturbed, bees and wasps drive a needle-like stinger into a victim's flesh and inject a venomous fluid. The venom causes painful swelling that may last several days. Stings may prove fatal to persons allergic to the venom who do not immediately use an anti-venom or consult a doctor.

Africanized honeybees or “Highly Defensive Bees” are a serious health and safety threat due to their aggressive nature. The Africanized bees will respond to threats to the hive by sending out as many as ten times the number of European bees to protect the hive, resulting in more incidences of bee stings and multiple sting events. Africanized bees have also been known to follow a moving target after stinging has begun.

Africanized bees and European honeybees can live almost anywhere around buildings, making the Africanized bee an even greater threat. Nesting sites include hollow tree wells, chimneys, storage, in trees, in abandoned automobiles, under eaves or overhangs and anywhere they can find shelter from the sun large enough to protect their wax combs. Eliminating access to

potential nesting sites when possible is one way to prevent honeybee infestation. This can be accomplished by:

- Removing and discarding stored items around the exterior of buildings and grounds.
- Repairing holes in exterior walls to prevent bees from nesting in the hollow wall areas.
- Install fine meshed (.3 cm [1/8 in] hardware cloth) screens over tops of rain spouts, vents and openings in utility boxes.
- Secure sheds and outbuildings; close void areas if possible.

INSPECTION AND MONITORING

Inspect areas above doorways, holes leading into structures, and hollow trees or rotten tree stumps for stinging-insect nests. Monitor garbage cans for the numbers of wasps or bees feeding there over a set period of time. Take management action when fifteen or more foraging wasps or bees visit an open garbage can in ten minutes. Good records should allow correlation of stings with numbers of foragers. This monitoring information can be used to predict when action may need to be taken to manage these generally beneficial insects.

Heed the following precautions when working with wasps and bees:

- Listen for buzzing indicating presence of bees nearby.
- Use caution when entering sheds, outbuildings or any storage area that is infrequently accessed.
- Inspect work areas before using outdoor power equipment including lawnmowers and weed cutters.
- Perform exterior inspections of buildings and outbuildings regularly (at least twice per year).
- From spring to fall, check once or twice a week for bees entering or leaving the same area of the building or yard.
- Teach staff to be cautious and respectful around all bees.

Treatment for Wasp and Bee Stings

If stung by a wasp or bee, take the following steps:

- Go quickly to a safe area inside a building and close the door.
- Remove stinger(s) as soon as possible.
- Don't squeeze the stinger; pressure will release more venom.
- Scrape the stinger out with fingernail, knife blade or credit card.
- Wash the sting area with soap and water.
- Apply an ice pack for a few minutes to relieve pain and swelling.
- Seek medical attention if breathing is troubled, if stung numerous times or if allergic to bee stings.

MANAGEMENT

Sanitation

Good sanitation manages the amount of food available to wasps. Denying food forces worker wasps to find less abundant natural prey and limits the amount of nutrition which larvae receive during periods of exponential colony growth. This ultimately restricts the colony size.

Following are sanitation measures which will reduce wasp and bee problems:

- Keep garbage cans tightly closed.
- Check cans often for gaps and holes; request frequent garbage pickup.
- Install garbage liners in cans and promptly clean up garbage spills.
- Frequently clean both inside and outside of garbage cans with steam or soap and water.
- Move dumpsters and trash barrels away from doorways or other areas of human traffic.
- Prevent the accumulation of standing liquid waste from garbage or dumpster containers underneath the dumpster or in low-lying areas.
- During summer, yellow jackets are attracted to meat; keep food covered.
- Clean up all food or drink spills that attract bees and wasps. Wipe outdoor food-preparation surfaces and picnic-table tops with appropriate cleaning solutions.

Exclusion

Some methods of exclusion appropriate to a public building site are:

- Assure that all doors and windows close tightly and that screens are in good condition.
- Frequently and carefully inspect structural exteriors and seal all possible wasp or bee entry spots.
- Seal holes in hollow trees and remove rotten stumps.

Physical, Mechanical, and Cultural Measures

Whenever working around wasps and bees, wear protective bee veils and coveralls. Do not allow bystanders and pets to remain nearby. Approach honey bee nests on warm and calm days. Bees are more aggressive on cloudy and windy days when foraging is not possible. Avoid walking through the flight paths of foraging wasps and bees leaving and returning to the colony. At night, avoid shining lights or casting shadows on the nests; use red lights when working on colonies at night. Walk softly near ground-nesting bees and wasps to avoid making vibrations that alert the bees. Carefully and slowly brush off a bee or wasp that lands on a person, or wait until it flies off. Inspect and remove all small wasp nests early in the spring, while nests are still small. Removal at this time of the year is easily done with a broom, vacuum cleaner, garden hose, or other mechanical means. Later, nests will be much larger and better guarded by workers. Watch for honey bee swarms in April and May when they begin to search for new nesting places: including holes leading into structural voids. Swarms can be discouraged from nest establishment in buildings by various mechanical means such as providing a hive box.

Nesting pests in wall voids can be detected by using a stethoscope. Yellow jacket nests in wall voids do not necessarily require removal since they do not contain honey and are not reused in the following year. Abandoned nests, however, may attract fabric pests such as dermestid beetles. Do not seal up active nests before killing the insects. If wasps or yellow jackets are sealed into wall voids without an exit, they will chew through the wall to exit somewhere else, even into the interior of the building. If honey bees are sealed into wall voids, melting honey will spoil, rot, and stain the wall. After destroying and removing nests, close up holes with copper gauze, caulk, duct tape, spackle, putty or screening.

Use outdoor lights that are not attractive to insects. Remove stumps, dead limbs and hollow trees that can be used for nest sites. Remove plants that attract wasps and bees, including those that are vulnerable to scale or aphid attack which produce honeydew food sources for wasps.

Sticky or jar traps may be used to capture wasps, however, traps reduce only a small number of foragers.

Keep a list of local bee keepers who may voluntarily remove honeybee nests. Remove dead honeybee colonies and residue from walls so remaining organic debris and odor does not attract more insects.

Don't go barefoot; don't make unnecessary movements, and don't strike at individual wasps or bees flying nearby. In areas frequented by such insects, avoid wearing perfumes, scents, hair spray, suntan lotion, shaving lotions, talcum powder, cosmetics, and brightly colored or highly patterned clothing, which are attractive to bees and wasps. Examine wet towels before use to see if insects are taking moisture from them. Reduce honey bees on lawns by closely mowing clover and flower heads.

Other Measures

Biological

Biological methods show little promise; parasites, predators, and pathogens are mostly effective only on small, weakened colonies.

Heat

Wet or dry temperatures of 54°C (130°F) effectively kill wasps and bees. If an infested area is covered with a plastic tarp, the summer sun generates sufficient heat to kill them.

Vacuum

Wasp and bee nests can be removed with an industrial vacuum cleaner. (Wear protective clothing.) Be sure the vacuum nozzle is placed over the only entrance hole before disturbing the nest. When the last of the colony is removed, plug the vacuum bag with cotton and heat it in the sun to kill the insects.

Pesticides

Poison Baits

When deemed necessary, pesticide applications shall be performed by licensed applicators only.

Applications shall be made according to National Park Service policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

A number of commercial pesticides are available which foraging wasps and bees carry into the nest. Choose the appropriate bait material to mix with the insecticide depending on feeding habits, which change with the season. Poison baits should not be accessible to children and nontarget insects and animals.

Aerosol Sprays for Aerial Nests

A number of commercial aerosol preparations are available that quickly and safely destroy aerial wasp and bee nests. Follow label directions.

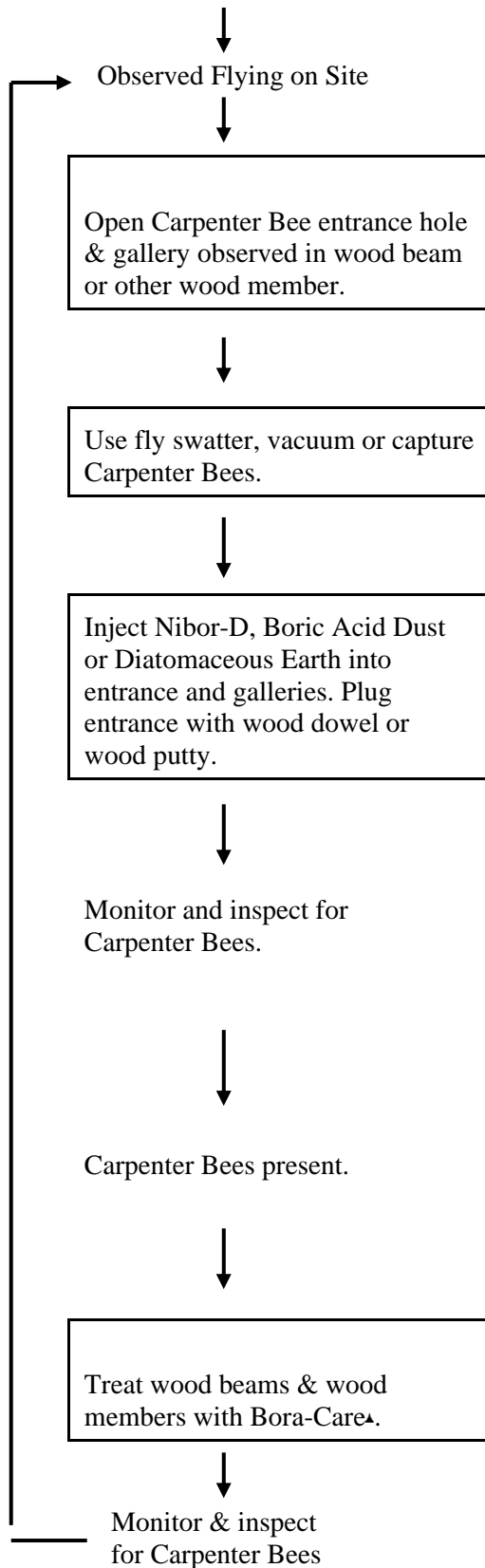
Insecticides for Subterranean Nests

After locating and sealing all entrances but one, properly labeled insecticides can be poured into subterranean colonies and the entrance plugged.

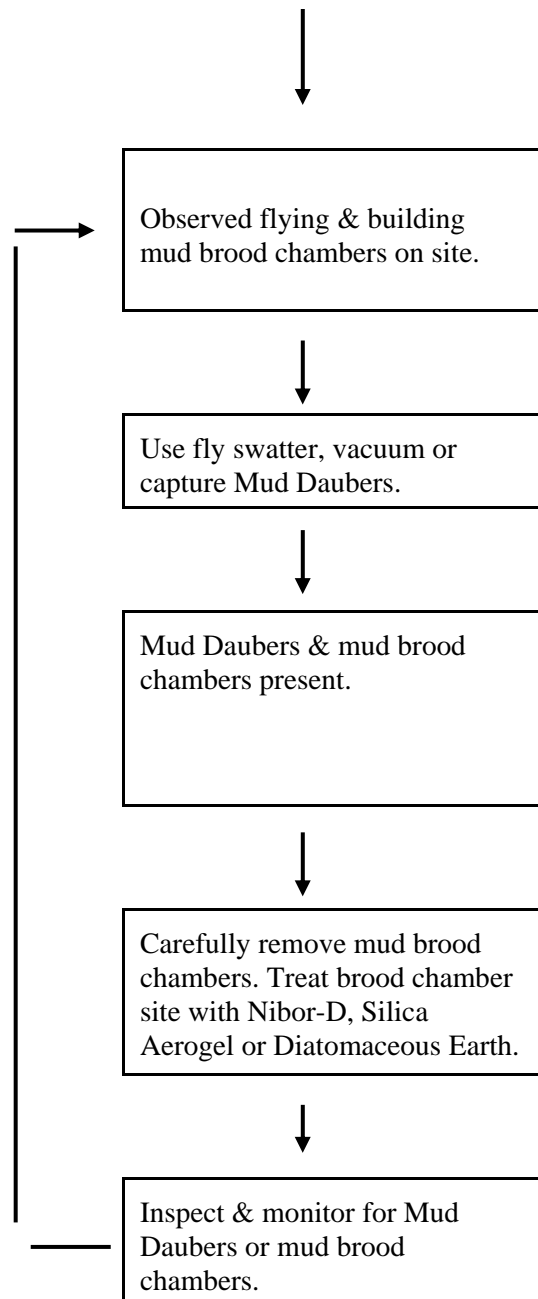
Dusts and Aerosols for Wasp and Bee Nests in Wall Voids and Attics

A number of residual pesticide dusts and aerosol formulations are available to treat nests in building walls and attics. Follow label directions. Having found the location of a nest (listening for buzzing behind plasterboard), drill a hole and inject aerosol or dust directly into the colony. Killing honey bees in walls with pesticides causes deterioration of honey and nest combs and attracts other bees and troublesome insects; melting honey and wax may stain walls unless the structure is opened up to remove the debris. Contact your local beekeeper association for assistance, if necessary, to remove honey bees by means other than pesticides. Do not seal all entrances of nests located in building walls without killing the colony since wasps and bees may find an exit into the interior of the building.

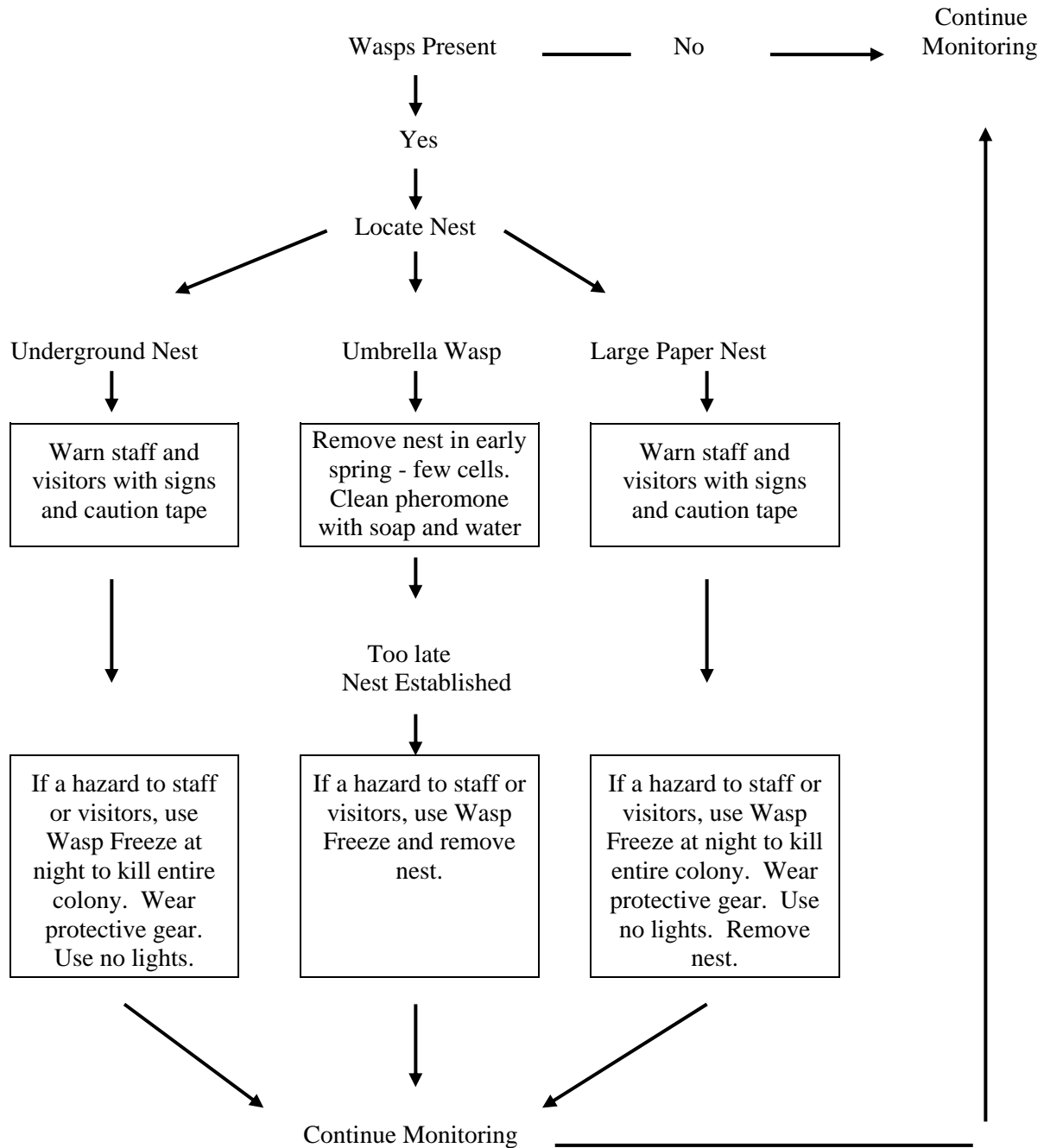
CARPENTER BEES



MUD DAUBERS



WASPS



SPIDERS

CHARACTERISTICS AND RECOGNITION

General

Only a few species of spiders live in structures; most are accidentally carried into buildings on firewood, laundry, or plants. Since they feed on insects, they are rarely problems in buildings that do not have an insect food source. They are objectionable pests to people fearful of them, even though most are harmless. There are only two spiders considered dangerous to human beings in the United States: the black widow and the brown recluse. These generic names, however, represent several different species. The following discussion describes these two spiders, but generally applies to all spiders.

Black Widow Spider

Several kinds of black widow spiders are widely distributed over the eastern, southern, western, and northwestern states of this country. Black widow spiders are normally outdoor species that sometimes move or are accidentally brought indoors. Young spiders may migrate inside on ground-floor levels. Outside, the black widow can be found in crawl spaces and bird nests, on low-growing plants and grape arbors, and under porches, garages, and sheds. They are also found in stacked pots, baskets, boards, firewood piles, rodent burrows, and water meters, and under bricks and stones.



Female Black Widow with Egg Sac



Female Black Widow

The female black widow has poison glands and fangs with which she kills insect prey. These spiders can go for as long as three to four months without eating. Although the female black widow rarely leaves the web, males are more adventurous, especially when seeking a mate. When they first hatch, males are slightly venomous, but the potency of venom is lost as they mature. Male black widow spiders are not dangerous to people.

The adult female black widow spider has a shiny black abdomen that is usually decorated on the underside with red or yellow-red markings resembling an hourglass. This mark is visible when the female hangs upside down in the web. The markings, which may be absent, vary in different individuals from that of a typical hourglass shape to a pattern of two or more triangles; occasionally, some spiders may only possess a long, irregularly colored area. Male black widow spiders are small, white, and streaked with red, white, or yellow. Female black widows are about 1.27 cm (1/2 in) long; males are only about half that size and have longer legs.

The adult female black widow spider is primarily nocturnal. She weaves tangled webs of coarse silk in dark locations, and in late summer she begins to lay batches of eggs in units of 300 to 400 on the web. Four to nine batches of eggs, covered with a silken sac, can be produced during a season. The female guards the egg capsules and moves them as necessary when repairing the web. Females tend to be hungry and aggressive after egg laying, during which time most human-related bites seem to occur. Eggs hatch in eight to 10 days, and the young disperse by riding air currents on short strands of web. Young black widows mature in about four months and only mate once. Although some believe the female kills the male after mating (hence, the name "widow"), others contend that the female rarely does so. The life span of a spider is from eighteen to twenty-four months.

Brown Recluse Spider

Seven varieties of brown recluse spiders make up this group. These are dusky-tan or brown spiders that range over most of the United States, sometimes "hitch-hiking" into dwellings on luggage or household furnishings imported from other places.



Brown Recluse Spider

The brown recluse spider is an outdoor species that hunts at night. It doesn't use a web to capture prey; but rather runs fast to overtake it instead. In the south, the brown recluse lives under loose bark, in woodpiles, under sheds and beneath debris. In the north, it has to live indoors, especially in the sleeves of clothing hung for long periods of time in closets. The brown recluse spider has a high moisture requirement, and is often found near water heaters. It may also be found behind or under furniture and boxes.

The brown recluse is a medium-sized spider (about .79 – 1.27 cm [5/16 – 1/2 in]) and smaller than the black widow. Unlike the black widow, the brown recluse has an oval abdomen that is uniformly tan-to-dark brown and without markings. A dark "violin-shaped" fiddle back mark is obvious on the cephalothorax (combined head and thorax portions) on most species. The broad base of the fiddle begins at the eyes and the narrow part of the fiddle neck ends just above the attachment of the abdomen. The brown recluse has three pairs of eyes (in groups of two) placed in a semi-circular pattern (rather than four pairs for most other spiders). Its legs are long, the second pair longer than the first.

Although the brown recluse makes a fine, irregular web, it wanders around to hunt after

maturing. During a lifetime, females produce one to five egg cases of 30 to 50 eggs each. Eggs are placed on the web in a loosely woven sac of wispy sheets of silk. Usually one or two young spiders per brood survive, because adults are cannibalistic (and also feed on black widow spiders). Recluse spiders mature in seven to twelve months, and they generally live one or two years.

HAZARDS OF INFESTATION

Black Widow Spider Bites

Death results in less than four percent of persons bitten by black widow spiders. Strong, healthy adults rarely succumb to a bite, but young children are more vulnerable. Deaths among the elderly are usually the result of complications beyond the spider's bite.

Female black widow spiders are quite timid and usually make no effort to bite, even when provoked. Bites may occur when a spider is accidentally squeezed against a person's body. Spiders make webs in the folds of clothing, shoes, or under objects in dark corners.

The severity of the black widow bite depends on the amount of venom injected, age and condition of both the victim and the spider, part of the body bitten, degree of immunity of the victim, and treatment given. A black widow spider bite is not always felt, and in most cases, only two tiny spots along with redness appear at the bite site. Pain begins to increase around the bite after half an hour or more, along with other symptoms such as headache, dizziness, shortness of breath, and abdominal and back pain. The pain lasts for 12 to 48 hours and is generally worse by the second or third hour. Muscles in the victim's abdomen become rigid, and the person may develop nausea and, in some cases, convulsions.

How to Treat a Black Widow Bite

Anyone bitten by a black widow spider should be treated for shock by being kept quiet, preferably in bed and covered with a blanket. Victims should receive hospital treatment as soon as possible; antivenom is readily available to most physicians. If a doctor is not available, wash the skin around the bite but make sure any venom still remaining on the skin is flushed away from and not into the wound. A recommendation is to continually apply ice to the bite site, since cold delays absorption of the poison and gives the body an opportunity to neutralize the venom. Never administer alcohol since it increases sensitivity to the venom. Give the patient plenty of water and sweet weak tea.

Brown Recluse Spider Bites

Brown recluse spiders generally avoid areas of human activity, and are usually found only in unused rooms. Even though indoor infestations may be large, household residents are seldom bitten. The brown recluse is not aggressive but bites and causes severe wounds when squeezed against a person's skin, as in putting on shoes or clothing (most bites occur on arms and legs). Bites can be expected when previously unused rooms are occupied or when clothing stored for a long time in closets is brought out for use. Brown recluse bites sometimes produce a sharp sensation at first, which may be mistaken for a bee sting or insect bite. However, it may not be noticed at all. Victims may not realize the full extent of the trouble for eight to 12 hours, when

pain becomes intense. A reddened area and accompanying painful swelling develop at the bite, and nausea, vomiting, fever, and a rash may follow. The site of the bite becomes dark and dry and after seven to 14 days, tissue surrounding the bite becomes an open ulcerous wound. Without prompt medical attention and over a period of days, the ulcerous wound becomes a festering sore. Although scabs may form over the wound, they tend to fall off and the wound continually grows deeper and fails to heal for several months (up to a year). There is always the potential for gangrenous infection and skin grafts are sometimes required to close the wound. Death from bites is extremely rare, but bites are very debilitating and traumatic.

How to Treat a Brown Recluse Bite

Apply ice to a bite as soon as possible, elevate the limb, and take the victim and captured spider (if possible) to a physician. The brown recluse is a delicate spider and after a bite it can usually be found near where it was slapped by the victim. The spider should be killed (without destroying it so it can be identified) and taken with the victim to the physician. Identification of the spider is important for proper treatment because a few other biting arthropods produce similar injury.

Other Hazards

Some spider webs may clog vent pipes and trap fumes or odors inside structures.

INSPECTION AND MONITORING

Move cautiously when inspecting or treating any sites where there is potential spider harborage.

Inspecting For Recluse Spiders

Wear long sleeves, long pants, socks, and gloves and use a flashlight during inspections along walls in little-used, cluttered storage areas such as closets and attics. Look for loose irregular webs, cast skins and silky egg cases (about .84 cm [1/3 in] in diameter) but avoid placing hands into dark places. Spiders shed their skins in order to grow. These "cast" skins are fragile but retain a characteristic violin marking. Such skins indicate infestation.

Inspect behind and under furniture, in kitchen and bathroom cabinets, closets, ceiling light fixtures, stacks of firewood, and water heater closets. Other locations for inspection should include mattresses and bedding; walls and floors and stacked boxes, bags, papers in store rooms and sheds; behind picture frames; under stairs; and hanging clothing that has not been used for some time. Concentrate on areas outside daily traffic patterns.

Outdoors, brown recluses are found between the soil and foundations, under door stoops, and in window wells.

Monitoring Brown Recluse Spiders

The presence of brown recluse spiders can be monitored in sticky traps. Tent-top or other sticky traps with covers seem the most effective.

MANAGEMENT

General

Spiders should be conserved whenever possible; they are natural control agents for many pests.

Major Mistakes in Spider Management Procedures

The following are the mistakes made in spider management procedures:

- Spiders are re-introduced into structures by way of firewood, laundry, and flowers.
- Failure to eliminate the insect food source.
- Over-responding in management measures due to spider misidentification.
- Extensive pesticide application when only a few harmless spiders are present, which could be managed by physical or mechanical means.

Physical, Mechanical, and Cultural Measures

Sanitation

Habitat modification, good sanitation, and exclusion are absolutely necessary for long-term spider elimination; inform occupants of the need and the techniques.

Frequently and thoroughly vacuum (with an industrial vacuum) all cracks and crevices, closets, behind furniture, and mop floors to destroy webs, egg sacs, and young spiders. Clean dark corners inside the structure using leather or rubber gloves. Concentrate efforts for brown recluse management in seldom-used rooms. Remove webs off exterior of building so that spiders leave.

Remove lumber, scrap, rubbish, and debris from near and under buildings and frequently clean rain gutters. Stack firewood, brick, and stone piles away from buildings; inspect firewood for spiders and egg sacs. Keep grass mowed and cut very short next to buildings; establish a three foot swathe of gravel cleared of vegetation all around buildings. Keep trees and shrubs trimmed back at least three feet from structural walls. Pick up leaf litter and other debris in yard, especially next to buildings.

Make occupants aware that spiders are often introduced into structures on firewood, lawn furniture, garden implements, and children's toys. Remove the bark from firewood before bringing it inside; don't bring in any more wood than will be burned in an hour or two.

Perform annual spring cleaning: turn mattresses, clean closets; dispose of unused items, rotate seldom-used items in garages, under beds; neatly stack items inside away from walls; remove

and wash all bedding; remove and clean drawers from dressers and remove cobwebs. This is very important for brown recluse management because it interrupts the spider's reclusive habits. Re-inspect spaces disturbed by dusting, vacuuming, and mopping the same evening, and kill any moving spiders.

Inspect winter clothing and other unused closets during spring and summer. Before returning clothing to storage, clean it and pack it in sealed plastic bags.

Repair all water leaks and sources of condensation on pipes.

Reduce the numbers of insects in and around building. To avoid attracting spiders, arrange outside lighting so as not to attract insects. Move lights onto poles and away from structures. Trim weeds and remove debris around foundations, caulk entry holes, install tight-fitting screens and door sweeps. Spiders need a ready supply of insects to survive and invade structures infested with insects.

Regularly clean floors and baseboards and remove debris. Do not leave old clothing, bedding, boxes or piles of paper on floors.

Thoroughly clean attached garages and basements, crawlspaces, and outbuildings.

Dry out crawlspaces or spider problems will recur.

Exclusion

Inspect doors and window casings to be sure screens function properly. Caulk holes large enough to admit spiders including openings around water pipes and electrical lines. Keep tubs, sinks, and drains stopped at night. Install tight-fitting door sweeps to exclude spiders and crawling insects.

Other Measures

Biological

Mud dauber wasps, birds, rodents, and predatory insects prey on spiders.

Heat

Infested rooms can be treated by heating them to over 49°C (120°F) for one-half hour.

Direct Measures

Step on individual spiders, kill them with a fly swatter, or remove them with a vacuum.

Pesticides

When deemed necessary, pesticide applications can be performed by licensed applicators only. Applications shall be made according to the National Park Service Integrated Pest Management policy and procedures guidelines, according to pesticide label directions, and following applicable laws and regulations.

Pesticides, when used, should be combined with nonchemical measures. Although spiders are susceptible to most insecticides, chemicals are seldom used because of difficulties in getting spiders into contact with pesticides: they do not ingest pesticides during grooming and walk on hairs on their feet which prevent surface contact.

Web-building spiders seldom leave their webs.

Pesticide dusts, however, are sometimes applied in attics and crawlspaces. If a good spider reduction is done in the fall, few problems should occur until early to late summer of the next year.

When using pesticides to treat structures for spiders, warn occupants to be cautious in rooms that were treated, because spiders not killed will wander for a few days following treatment.

Carefully analyze the microhabitat occupied by problem spiders and use appropriate nonchemical and management methods.

Indoors

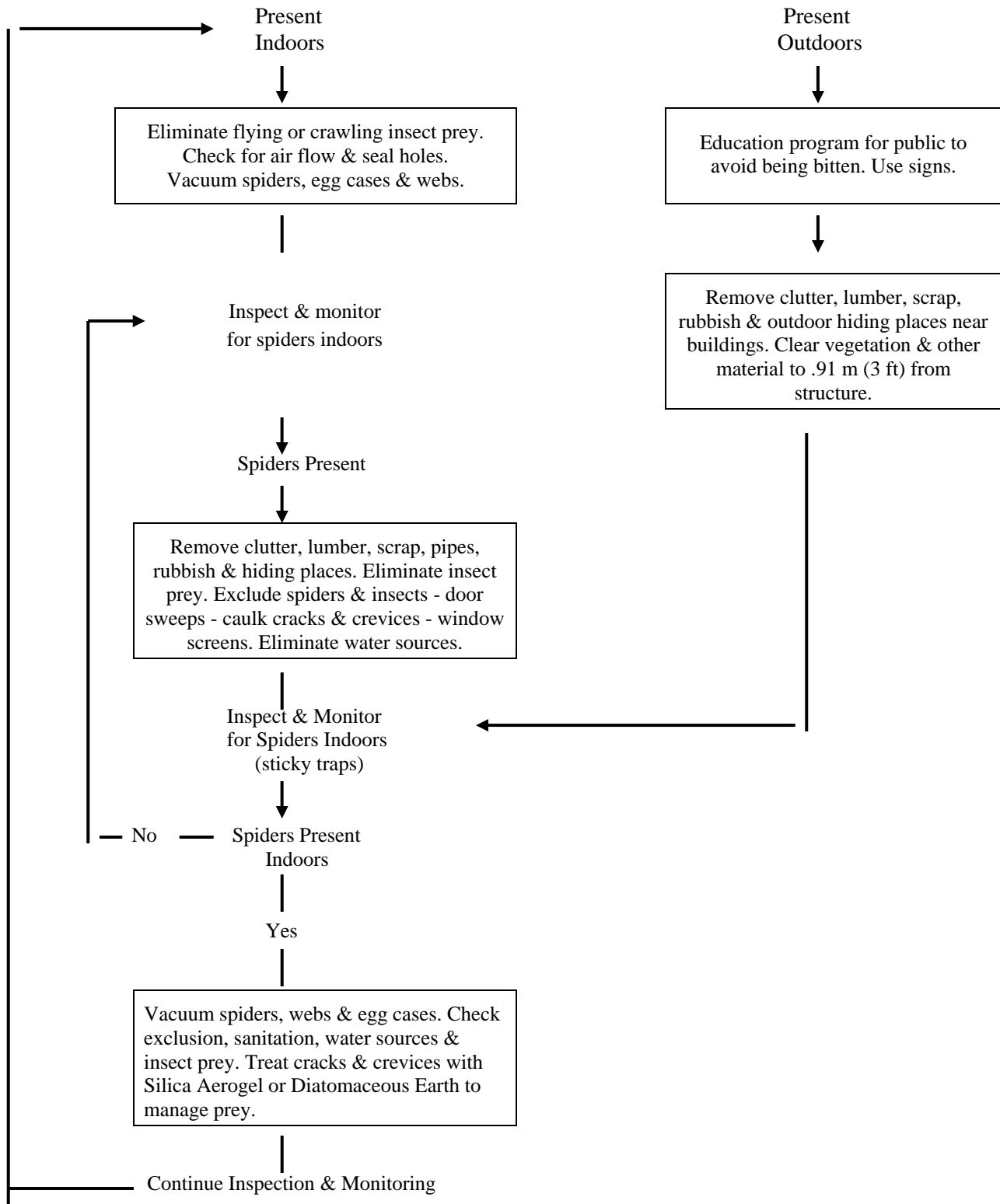
If necessary, use crack-and-crevice application dusts such as diatomaceous earth to treat the structure, including attic and crawlspace, window and door frames and casings, baseboards, cracks and crevices, room corners, beneath and behind furniture, closet bottoms, and garage in order to reduce insects spiders feed on. Since web-building spiders recycle silk (eat and digest old webs); light dust applications on webs may be effective.

If spider populations are not reduced, spot-treat areas of infestation with residual pesticides by directing insecticide into voids, cracks, and crevices.

Outside

Using the above techniques and materials, treat around foundations, windows, doorways, pipe openings, wooden fences, weep holes in brick walls or veneers, and building perimeters. Dustings should be wide-spread to eliminate spiders before they enter the dwelling. There is no need to treat the lawn. Follow label directions.

SPIDERS



TICKS

GENERAL

Ticks have recurved teeth or ridges on the central mouthparts (called the holdfast organ). They also have, on each of the first pair of legs, a sensory pit which detects stimuli such as heat and carbon dioxide. Ticks also detect light and dark as well as shapes, shadows, and vibrations—all stimuli that help them find their hosts. Soft ticks are not likely to be found at SAGA.

Worldwide, there are over 650 species of hard ticks.

Some ticks live their entire lives on one host, while others spend only their larval and nymphal stages on a single host; then drop off as an adult to find another host. Most ticks, however, have three hosts, one for each stage.

Life Cycle

Seed Ticks

Normally, thousands of tiny larvae hatch from a batch of eggs and crawl randomly in the surrounding area; larvae (or seed ticks) have only three pair of legs. Some attach to a small mammal or lizard. They suck blood. Their feeding (or engorgement) time lasts for hours or a day or so since they are small. The host may distribute them while wandering away from the site of the initial encounter. When the engorged seed ticks drop off, they are still usually in or near an animal run.

Nymph

After molting, the nymph climbs grass leaves or a plant stem. Ticks climb progressively higher as they develop, so that different stages reach different layers of vegetation. Because of this, developing ticks find larger hosts than they had during the previous stage. After several days of feeding, the engorged nymph drops off its host and molts. Nymphs and adult ticks have four pair of legs.

Adult

The adult climbs vegetation, stretches its front pair of legs, and waits for vibrations or a shadow announcing a nearby host. Ticks sometimes wait for months or more for a suitable host. If heat or carbon dioxide is detected (for instance, from a passing mouse), the tick will seek it out. As the host passes by, claws located at the tips of the tick's legs grab hold of the host, and the tick moves to a place where it can engorge.

Attachment and Feeding

Adult female hard ticks will feed for several days to more than a week. Ticks usually grasp human hosts from a point close to the ground and crawl upwards until constricted by tight clothing or reach the head. On wild mammals or pets, they move until they reach the highest point on the host, the head or ears.

The tick's ability to creep undetected is matched only by its ability to attach for feeding without the notice of the host; stealth keeps ticks from being scratched off by the host before they can attach. When feeding is complete, the engorged female drops off of the host, lays eggs, then dies.

TICK RECOGNITION

American Dog Tick



American Dog Tick

Larvae and nymphs of the American dog tick, *Dermacentor variabilis*, prefer small rodents especially *Microtus*, the short tailed voles, called meadow mice.

The adults, which are slightly over .3 cm (1/8 in) long, are found on dogs and people. The adult female is brown with a pearly light anterior dorsal shield. Males are brown-backed with pearly streaks. Both sexes have eyes, or unpigmented light-receiving areas, at the edges of the shield.

With a favorable food supply, American dog ticks can complete their life cycle in three months, with the female laying up to 6,500 eggs in late summer. Warm springs promote early adult and larval activity and egg-laying.

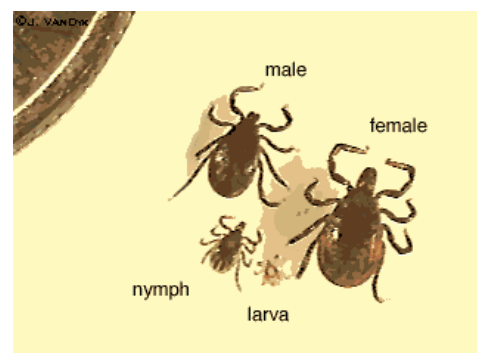
Adult ticks usually contact people on the lower extremities and crawl upwards until they are stopped by constricting clothing. Loose clothing allows ticks to proceed as far as the head. Because of possible communication of Rocky Mountain Spotted Fever (RMSF), any tick attachment should be noted and the victim observed for symptoms.

Deer Tick

The deer tick, *Ixodes scapularis* Say, larvae are very small. Nymphs are close in size to the adult, a little less than .15 cm (1/16 in), or the size of the head of a pin. Adult deer ticks are the size of a sesame seed. Deer ticks have a two-year life cycle and utilize three different hosts.

Eggs and Larvae

Eggs of the deer tick are laid in the spring by overwintering females. Tiny larvae hatch and feed on deer mice and white-footed mice in the late summer. Larvae can feed on human beings but will not transmit Lyme disease. After overwintering, larvae molt into the nymphal stage the following spring.



Deer Ticks

Nymphs

Nymphs are ready to feed in May and June. The body of the nymph is tan with black legs and a black shield (scutum) near its front. Nymphs climb vegetation and attach to passing animals such as dogs, cats, horses, cattle, raccoons, opossums, mice, migrating birds, and people.

Nymphs live in woodlands: bushy, low shrub regions and grassy areas where they can infect animals and people. Most human Lyme disease cases are the result of nymphal tick feeding. The remainder is due to adult activity. Nymphs usually molt into the adult stage in late summer, although they sometimes overwinter and molt in the spring.

Adults

The body of the adult female is brick red with black legs; she has a black shield (scutum) in the front. The male is entirely dark and smaller than the female. Adults feed in late fall or spring as well as on warm days in winter.

TICKS AND DISEASES

Several species of hard ticks are responsible for the spread and increase of Lyme disease and the persistence of Rocky Mountain Spotted Fever (RMSF).

Lyme Disease

Lyme disease is caused by a spirochaete (a spiral shaped bacteria). Symptoms vary and may resemble other diseases; many cases go undetected. The first indication of a potential infection may be the discovery of an attached *Ixodes* tick. Disease transmission does not occur until an estimated 10 – 12 hours after feeding begins, if the tick is located and removed within that time, no infection will occur. If infestation occurs, Lyme disease is a very debilitating and painful disease.

Rocky Mountain Spotted Fever (RMSF)

RMSF is caused by a rickettsia, a disease organism related to bacteria. It is an acute infectious disease characterized by pain in muscles and joints, fever, and spotty, red skin eruptions. At least four to six hours elapse after the American dog tick begins feeding before disease transmission begins. If ticks are removed during this noninfective period, infection will not occur.

Tick Paralysis

All species may cause tick paralysis if they feed at the base of the victim's skull for extended periods. Symptoms include paralysis of the arms and legs, followed by a general paralysis which can cause death. The victim can recover completely in a few hours, after the tick is removed.

TICK PEST MANAGEMENT

Where pest-management services are provided to a public site, it is important to know what kinds of ticks are present, where they are most numerous, and what the disease potential in the

area is, and what the host and reservoir populations are. Pest-management programs are critical for effective management of tick species that transmit Lyme disease or Rocky Mountain spotted fever.

Inspection and Monitoring

Dragging

A commonly-used method of off-host sampling involves dragging a white flannel cloth over the ground or foliage where ticks are questing for passing hosts. Ticks cling to the cloth, and can be removed for counting and identification. Sample sites should represent favored tick habitats, and sampling should be done under conditions favoring tick presence (when vegetation is not wet, and when temperatures are above 10°C (50°F). All stages of ticks will attach to the flannel.

Dry Ice Collection

This technique appears to give more reproducible results than the drag technique. This technique involves placing a half-pound block of dry ice in the center of a .61 x .91 m (2 x 3 ft) panel of white polyester cloth on the ground at the chosen sampling site. The sampling sites should be selected in areas favoring ticks. After one hour, ticks on the top side of the panel are collected and can be counted.

Habitat Modification

Outdoor Areas

Dense shrub or tree cover or tall grass provides harborage for animal hosts of ticks, and protects ticks from losing body fluids resulting from drying winds and direct sunlight. Removal of excess brush and shrubbery, and pruning of overstory trees so that approximately 50% of a site is exposed to direct sunlight are recommended. Grass should not be allowed to grow more than six inches high, to allow ventilation and illumination of soil. Most ticks prefer the transition environment next to forested areas. Pesticides are rarely needed for ticks when vegetation management is practiced. Inspection of the site should be performed regularly to determine when pest management techniques should be conducted.

Indoor Areas

Methods of indoor tick management include regular inspection, elimination of animal harborage areas and entry, and animal-proofing of each site. The latter includes sealing of all holes in foundations and walls, and screening with heavy-gauge, 1/4 in. hardware cloth metal screen, along with vents, and other openings through which animals may enter.

Periodic surveys of potential or known habitats can reveal the presence of low-level tick infestations, thus indicating the need for application of management procedures (such as habitat modification) to prevent or retard further population increase.

Pest Management

Inside:

Use crack-and-crevice pesticide dust applications such as food grade diatomaceous earth where ticks hide. Treat under the edge of rugs, under furniture, in cracks around baseboards, windows, door frames, and in dog boxes. Fogging for ticks is useless.

Outside:

Managing the host animals is the most effective means to reduce tick populations. Pesticides are more effective when applied to paths frequented by animals. Treat low vegetation, including low shrubs, thoroughly. Mow around weedy fences that provide cover for rodents moving in from nearby woodland edges. Remove all vegetation at least .91 m (3 ft) from the structure. Broad application of pesticides to mowed grass does not reduce tick populations because the host, white-footed mice, does not infest lawns. Dust rodent runs or burrows in areas where human traffic cannot be controlled and where there is a danger of disease transmission.

Follow up

Continued monitoring and record-keeping is important. Tick counts should be reviewed at least annually to evaluate and adjust the pest-management program. Educational programs and materials for at-risk groups are vital.

Precautions for At-Risk Group Members

Wear long pants tucked into socks while working or hiking in tick habitat. Use insect repellents on clothes and cuffs. Schedule regular body inspections for ticks at noon and at bedtime: Nymphal deer ticks are small, but they can be seen with close inspection. Larval deer ticks cannot be spotted easily, but they are not disease carriers.

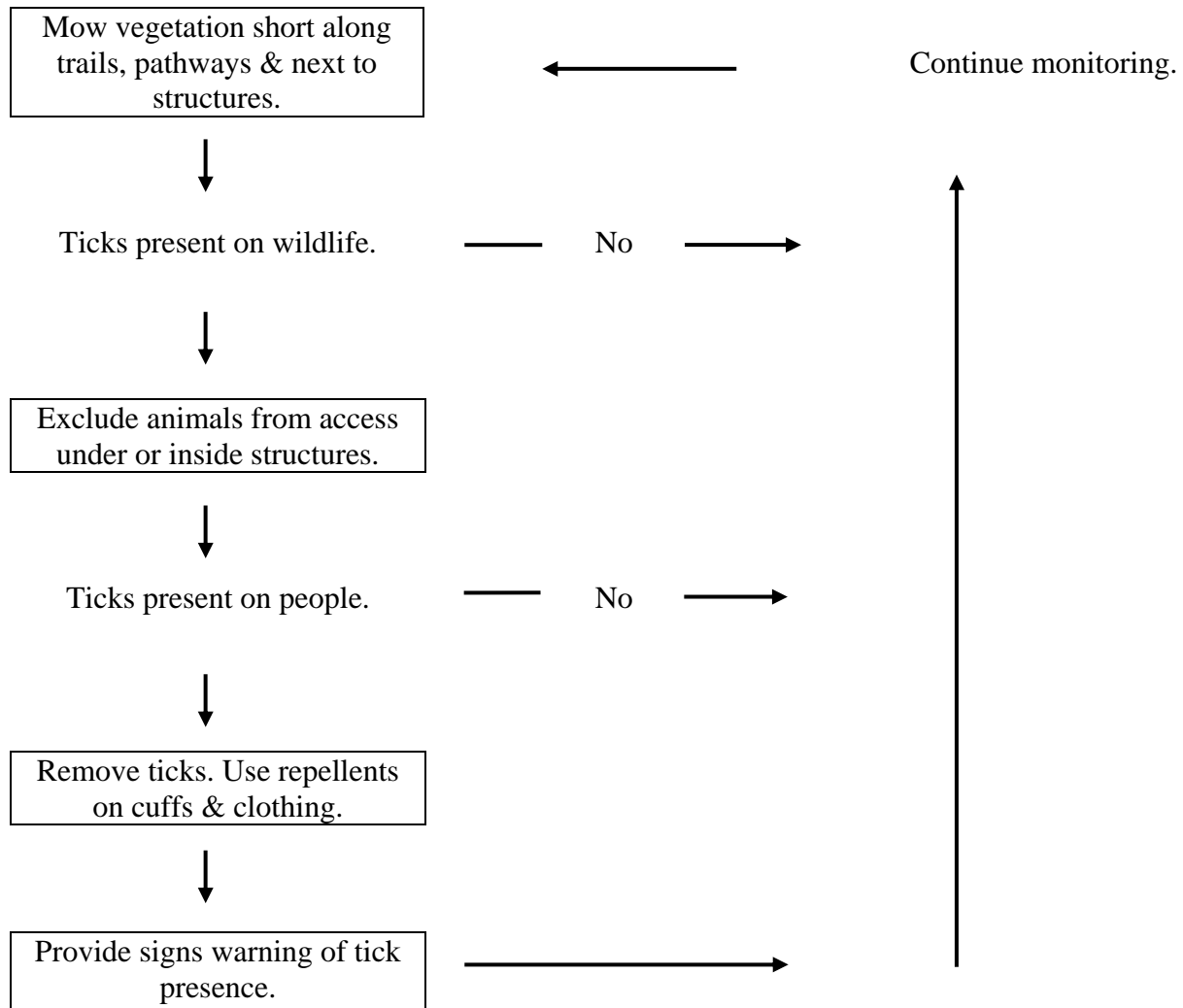
Tick Removal

Regular inspection, location, and early removal of ticks prevent disease transmission. To remove feeding ticks dab them with alcohol. If feeding has just started, and mouthparts are not cemented in, ticks sometimes pull their mouthparts out. If they do not release in a few minutes, take tweezers, grasp the tick at the skin level, and pull steadily until the tick is removed.

Grasping the tick by the back end, or heating it, can force disease organisms into the wound. Place the tick in alcohol or otherwise keep it for identification. If the mouthparts are left in the skin, they will not transmit the disease, but the wound should be treated with an antiseptic to prevent secondary infection. Note the date of removal to calculate the time of symptoms onset.

If the tick is identified as a deer tick, see a physician. If it is a RMSF carrier, look for symptoms within a week after exposure, if they occur notify a physician.

TICKS



MOSQUITOES

CHARACTERISTICS AND RECOGNITION

General

Mosquitoes usually are incidental pests in and around buildings, since their normal breeding habitats are outdoors. Mosquitoes may invade buildings during the warmer months from March to October.

Adult mosquitoes have one pair of oar-shaped wings that are partially covered with scales. The females have sharp, lancet-like proboscises used for sucking blood, whereas the males do not. Males have large bushy antennae. Eggs are laid singly or in rafts (depending upon species) either on or near the surface of a body of water. Larvae, sometimes called wrigglers, live in water, usually developing through four stages to become pupae. The larvae feed on organic debris on the bottom or suspended in shallow pools. The depth of pools inhabited by mosquitoes is limited by the need for larvae to return regularly to the surface to obtain air through an air tube on their posterior ends. Pupae have a "question-mark" shape and are active swimmers, but do not feed. Adult mosquitoes emerge from pupae at the surface of water, but usually do not feed until the second or third night after emergence. Their entire life cycle can take place in 10 – 14 days, depending upon temperature, with adults living less than two weeks on average.



Mosquito Larvae & Pupae

Biology of Domestic Mosquitoes

Aedes albopictus



***Aedes albopictus* Mosquito**

The Asian tiger mosquito, introduced from Asia in 1985, has spread to the eastern states south of New Jersey and the Midwestern U.S. east of the Mississippi River to the Great Lakes. The adults are black and white in appearance with a silver streak dividing the middle of the thorax.

The biology of this species is that they drink nectar between blood meals and eggs are deposited in artificial water containers. Eggs are placed into water in tree holes in addition to flower pots, vases, cans and

old tires. The females are less likely to feed on people than other mosquitoes. The egg stage over-winters in the northern states. Adults die when winter temperatures drop below 4°C (40°F).

This species is a known carrier of many arboviruses, including dengue, encephalitis viruses, and other viral diseases not normally indigenous to the United States.

Aedes vexans



***Aedes vexans* Mosquito**

Aedes vexans occurs throughout the continental United States and Alaska. The adult has an unmarked thorax and white bands on the legs and abdomen. It is a true floodwater breeder. Its larvae develop in large numbers following spring runoffs, when meadows and woodland pools are flooded. Unlike the other *Aedes*, this species prefers to lay eggs in sewage-contaminated water.

The egg stage overwinters in the northern states, while in the south larval development may continue year-round. Biting occurs in the early morning, early to late evening, or even daytime hours in shaded areas. Adults readily fly toward

lights at night; they also are migratory and may fly 10 miles or more from the larval habitat to seek hosts. This species feeds on domestic animals much more readily than *Aedes albopictus*.

Aedes vexans is a fair potential carrier of encephalitis viruses, WNV, and a moderately efficient carrier of dog heartworm. Moreover, it is such a persistent biter that even small populations are irritating.

Culex pipiens complex

House mosquitoes consist of several species, two of which are major pests in the United States. The northern species, *Culex pipiens* occurs in a band across the northern tier of the U.S. These house mosquito species overlap across the middle tier of states. They are a rather dull light brown with light white bands across the base of each abdominal segment.



***Culex pipiens* Mosquito**

The last abdominal segment is blunt at the end in contrast to the pointed abdomen of the aedine mosquitoes. The house mosquitoes lay egg rafts containing 200 or more eggs each in foul water such as ground pools, tire ruts, catch basins, open cesspools, and street and roof gutters. They may also lay eggs in basements, where larvae may continue to develop even in winter. Eggs hatch in a day or two and may develop through all larval stages in six to 10 days if temperatures are high, or several weeks if temperatures are low.

Although house mosquitoes are capable of transmitting encephalitis viruses, they are unlikely natural carriers because of their low human-blood feeding preference and comparatively short

life span. However, they are competent transmitters of West Nile virus (WNV). Adults of *Culex pipiens* feed principally in the evening on birds and domestic animals, but will feed on people if given the opportunity. Adults hibernate in the northern states, while breeding takes place year-round in the southern tier of states.

INSPECTION

When occupants express concerns about mosquitoes it should be determined which species are present, and where their larvae are. The species can be identified by determining if the abdomen is pointed (generally aedine species) or blunt (generally *Culex* species). The inspection starts on the basis of such identification. The aedine larval mosquitoes may be found in domestic water containers and tree holes, while the *Culex* species larval mosquitoes in foul water areas in and around the building. Identification of adult and larval mosquitoes is work for mosquito taxonomy specialists.

MOSQUITO MANAGEMENT

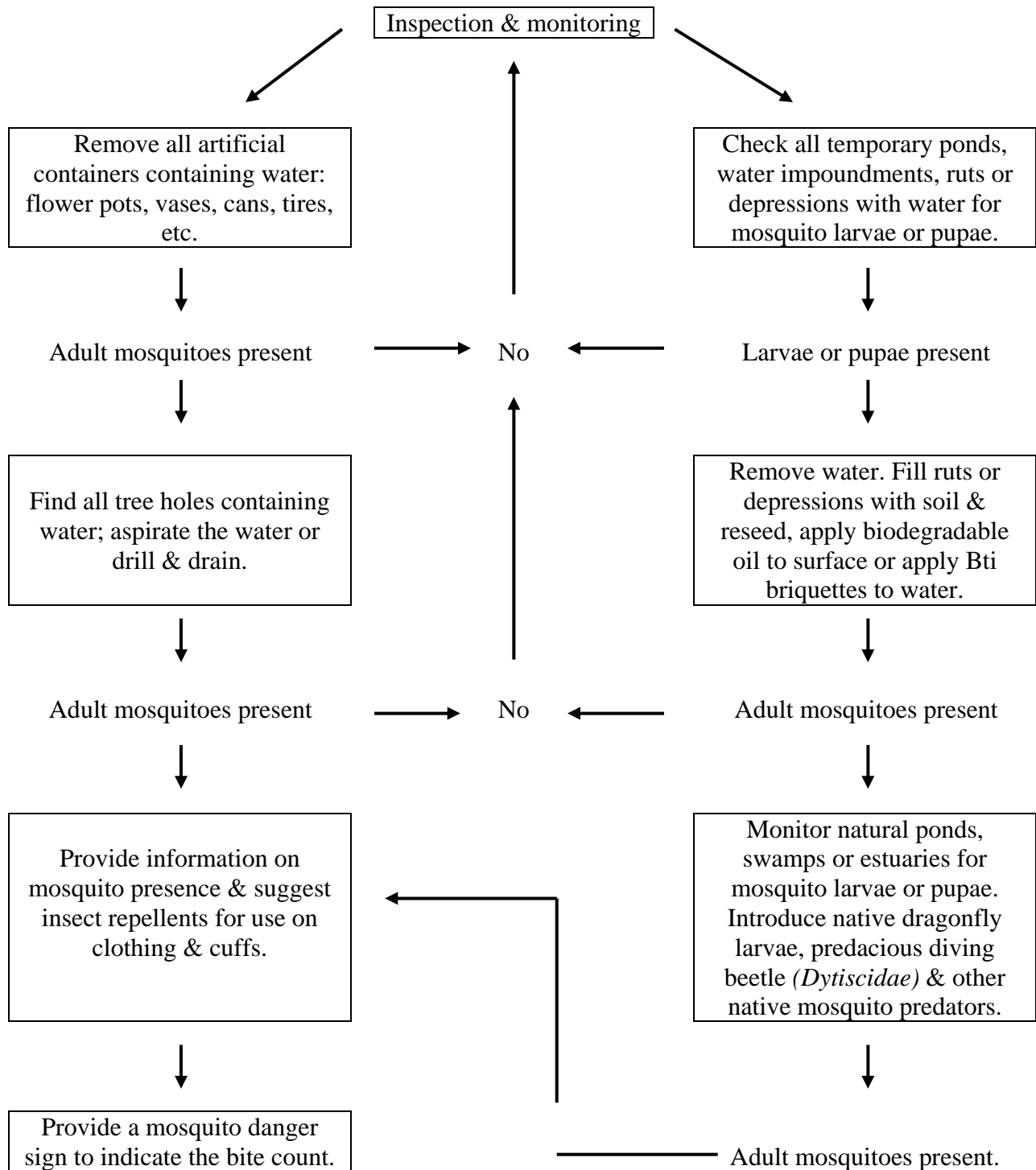
The best approach to managing mosquito populations is eliminating the larvae in their breeding habitat or the breeding habitat itself. A first step is not to keep water in pots, cans, or other containers. Often this just means letting plants dry out thoroughly between waterings. Major corrections may have to be made to reduce runoff from rains, especially in catch basins or in ground pools. Larger impoundments often produce predators such as frogs, fish, or predatory insects, so mosquitoes will not thrive there. Water in tree holes can usually be aspirated. If the water is removed in the spring, there will be no problem for months or perhaps even a year. Spaces having sewage backups or periodic flooding may require a permanent solution for continuous drainage.

If source reduction is not practical, mosquito larvicides may need to be used. This type of solution can become expensive if the larval habitats have to be continually retreated. There are relatively few pesticides registered for larval mosquito control in the U.S. Some of them include *Bacillus thuringiensis* (a bacterial insecticide) impregnated granules or "doughnuts." These formulations can be spread with a manual spreader where the breeding pools are small. Light biodegradable petroleum or vegetable oils spread on the surface of waters also manage larvae.

Adult mosquito management is frequently more challenging than larval control. Exclusion by use of screening is certainly the best means of preventing indoor infestations. Adult mosquito management, by black lights or "bug zappers" is ineffective outdoors and is destructive of the natural insect predators of mosquitoes such as crane flies and syrphid flies. Fogging or ultra low volume (ULV) treatment outdoors is rarely warranted or effective.

West Nile virus (WNV) is an exotic virus recently introduced into the United States that is of major concern as it has adverse effects on birds, horses and other animal species; and the elderly and very young humans. WNV is transmitted by several mosquito species. The most likely "competent" transmitters of WNV are *C. pipiens* and *Aedes vexans*. Infested water sources may be eliminated (drained or filled with soil) or treated with a larvicide or biodegradable oil. The introduction of mosquito fish can be used under certain circumstances (i.e., totally enclosed ponds so no possible escape, etc.). Adulticiding should be considered as a last resort.

MOSQUITOES



POISON IVY *Rhus toxicodendron*



Poison Ivy

Poison Ivy is a woody vine that is known for its ability to produce urushiol, a skin irritant that causes an itching rash for most people. The oil is in the leaves, vines and roots. Poison ivy grows throughout much of North America. It can grow as a shrub up to about 1.2 m (4 ft) tall, as a ground cover 10 – 25 cm (4 – 10 in) high, or as a climbing vine on various supports. Older vines on substantial supports send out lateral branches that may at first be mistaken for tree limbs. Poison ivy rarely grows at altitudes above 1,500 m (5,000 ft).

The leaves are compound with three almond-shaped leaflets. The berries are a grayish-white color and are a favorite winter food of some birds.

The color ranges from light green (usually the younger leaves) to dark green (mature leaves), and bright red in the fall. The leaf surface is smooth and has few or no teeth along the edges. The stem and vine are brown and woody.

The reaction caused by poison ivy, urushiol-induced contact dermatitis, is an allergic reaction. For this reason, some people are immune to its effects. However, sensitivity can develop over time. If poison ivy is burned and the smoke then inhaled, this rash will appear on the lining of the lungs, causing extreme pain and possibly fatal respiratory difficulty. If poison ivy is eaten, the digestive tract and airways will be affected, in some cases causing death.

Due to the potential human risks from exposure to the urushiol in poison ivy, management of this native plant can be difficult. Wear gloves, dust mask, goggles and other skin protection. Small plants can be mowed (repeatedly) when it moves into turf areas. Herbicides can be used to kill poison ivy; however, the dead vines must be removed and bagged for disposal. Do NOT burn poison ivy. Provide signage to warn visitors of the presence of poison ivy along pathways or other areas where it is present.



Poison Ivy in the Fall